

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. N. K. Gontia monitored and guided the research activities during the reporting period. 19th Research Council meeting was organized on January 17, 2022 for approval of new research programs and research activities during the year.

Table 4.1: Members of 19th Agricultural Research Council meeting

No.	Name	Designation
1	Prof. (Dr.) N. K. Gontia	Vice-Chancellor (I/c) (Chairman)
2	Dr. D. R. Mehta	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	Dr. K. B. Parmar	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. C. D. Lakhlani	Dean, Faculty of Agribusiness Management
13	Dr. R. B. Madariya	Convener, Crop Improvement AGRESCO Subcommittee
14	Dr. R. K. Mathukia	Convener, Crop Production AGRESCO Subcommittee
15	Dr. M. F. Acharya	Convener, Plant Protection AGRESCO Subcommittee
16	Dr. D. K. Varu	Convener, Horticulture AGRESCO Subcommittee
17	Dr. V. K. Tiwari	Convener, Agricultural Engg. AGRESCO Subcommittee
18	Dr. B. D. Savaliya	Convener, Animal Science AGRESCO Subcommittee
19	Dr. G. K. Kataria	Convener, Basic Science AGRESCO Subcommittee
20	Dr. N. B. Jadav	Convener, Social Science AGRESCO Subcommittee
21	Dr. K. L. Dobariya	Rtd. Research Scientist
22	Dr. B. M. Dabhi	Rtd. Research Scientist
23	Dr. P. D. Kumavat	Research Scientist (Sugarcane), Kodinar
24	Dr. D. R. Mehta	Professor & Head, Genetics & Plant Breeding
25	Dr. H. D. Rank	Professor & Head, Soil & Water Conservation Engineering
26	Dr. B. D. Savaliya	Research Scientist (AGB), Cattle Breeding Farm
27	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 the scientists and the Director of Research in two meetings held during the month of December, 2021 and February, 2022 for evaluation of expenditure of plan schemes and reallocation of the funds, etc.



State Programs

Monitoring of research work is done through a defined 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 ADR, 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 Action 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 Agricultural Research Subcommittee (one for all four State Agricultural Universities). All the committee meetings are held regularly 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)**

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
11	12094-00	Research for Integrated Pest Management in Fruit Crops	1997	Dept. of Entomology, Junagadh
12	12095-00	Strengthening of Horticulture Research & Development activities	1997	Dept. of Horticulture, Junagadh
13	12096-00	Research on Micro Irrigation System in Saurashtra Region	1997	Dept. of Agronomy, Junagadh



No.	Budget Head	Scheme Name	Sanction Year	Location
14	12131-00	Research on Eco-Friendly Biological Fertilizer	1997	Dept. of Pl. Patho., Junagadh
15	12712-5B	Campus Development Program (On Campus)	2004	Directorate of Res., Junagadh
16	12903-00	Establishing of Organic Farming Cell at Junagadh	2000	Dept. of Agronomy, Junagadh
17	12905-00	Proposal for Research on Watershed Management	2000	MDFRS, Targhadia; GRS, Dhari & Dept. of SWCE, CAET, Junagadh
18	12907-00	Strengthening of Agro-Meteorology at JAU	2000	PMRS, Jamnagar & ARS Mahuva
19	12930-00	Establishment of New Sub-Center for Research on Cumin	1998	Agriculture School, Halvad
20	12931-00	Establishment of New Research Centre on Onion Crop	2003	Vegetable Research Station, Junagadh & FRS, Mahuva
21	12573-00	Research on Tillage Technology	2006	Dept. of Agronomy, Junagadh
22	12574-00	Research on Rejuvenation of Degraded Coastal Agro-Eco Systems of Saurashtra	2006	Research Training & Testing Centre, Junagadh
23	12575-00	Strengthening Research in Sesamum	2006	Agril. Res. Station, Amreli
24	12101-01 to 04	Centre of Excellence on Soil and Water Management	2006	RTTC, Junagadh; MDFRS, Targhadia; ARS (FC), Mahuva & FRS, Mangrol
25	12576-00	Research on Post-Harvest Technology of Important Crops of Saurashtra	2006	Dept. of Processing & Food Engg., CAET, Junagadh
26	12582-00	Strengthening of Research on Genetically Modified Cotton	2009	Cotton Research Station, Junagadh
27	12583-00	Strengthening of Wheat Research	2009	Wheat Res. Station, Junagadh
28	12584-00	Strengthening Research on Castor	2009	Main Oilseeds Research Station, Junagadh
29	12585-00	Strengthening Research in Sugarcane	2009	Sugarcane Res. Stat., Kodinar
30	12586-00	Strengthening of Research in Plantation and Fruit Crops at A.R.S. (Fruit Crops)	2009	Agricultural Research Station (FC), Mahuva
31	12587-00	Conservation of Plant Biodiversity	2009	Dept. of Genetics & Plant Breeding, Junagadh
32	12588-00	Development of Arid and Semi-Arid Fruit Crops	2009	Dept. of Horti., Junagadh
33	12590-00	Establishment of Bt Cotton Research Centre at Surendranagar District	2011	Cotton Research Station, Kukada



No.	Budget Head	Scheme Name	Sanction Year	Location
34	12014-00	Establishment of Spices Research Centre at Junagadh	2011	Vegetable Res. Stat., Junagadh
35	12015-00	Establishment of Bio-Fertilizer Unit at Junagadh	2011	Dept. of Plant Pathology, Junagadh
36	12018-00	Establishment of Research Centre on Onion at Talaja Dist.: Bhavnagar	2011	Agriculture Research Station, Talaja
37	12019-00	Strengthening of Dry Farming Research at Jam Khambhaliya	2012	Dry Farming Research Station, JamKhambhaliya
38	12020-00	Strengthening of Dry Farming Research at Vallbhipur	2012	Dry Farming Research Station, Vallbhipur
39	12021-00	Establishment of Mango Res. Project at Talala	2012	Dept. of Horti., Junagadh
40	12022-00	Project on Mega Seed for Quality Seed Production & Distribution	2012	Dept. of Seed Science & Tech., Junagadh
41	12023-00	Micronutrients and Sulphur Research in Soils and Plants in Saurashtra Region	2012	Dept. of Ag. Chemistry & Soil Science Junagadh
42	12024-00	Centre of Remote Sensing and Geoinformatics in Agriculture	2012	Dept. of Soil & Water Consr. Engg., CAET, Junagadh
43	12025-00	Recycling of Organic Waste for Sustainable Soil Productivity under Dry Land Agri. at Targhadia	2012	Main Dry Farming Research Station, Targhadia
44	12026-00	Project For Research on Forage Crop Production at Dhari	2012	Grassland Res. Station, Dhari
45	12028-00	Aflatoxin and Its Management in Groundnut in Saurashtra Region of Gujarat	2013	Main Oilseed Research Station, Junagadh
46	12029-00	Molecular Mapping of Important Traits and their Transfer Through Marker Assisted Selection (MAS) in Groundnut and Cotton	2013	Dept. of Biochemistry, Junagadh
47	12030-00	Studies on Effect of Climate Change on Fruit Crops of Saurashtra Region	2013	Dept. of Horticulture, Junagadh
48	12303-05	Establishment of Gir Cattle & Jaffrabadi Buffaloes	1996	Cattle Breeding Farm, Junagadh
49	12953-00	Strengthening of Livestock & Veterinary Component	2002	Cattle Breeding Farm, Junagadh
50	12303-14	Integrated Farming System (Integrated Farming Combining Crop Livestock Bio Resources)	2009	Cattle Breeding Farm, Junagadh



No.	Budget Head	Scheme Name	Sanction Year	Location
51	12303-15	Establishment of Bull Mother Farm of Gir Cattle & Jaffrabadi Buffaloes	2011	Bull Mother Farm, Amreli
52	12950-00	Establishment and Development of Research in Fisheries	2000	Fisheries Res. Station, Okha
53	12578-00	Establishment of Inland Fishery Research Centre	2006	Inland Fisheries Research Station, Junagadh
54	12579-00	Establishment of Pearl Oyster Hatchery	2009	Fisheries Res. Station, Sikka
55	12581-00	Feasibility of Mass Culture of Marine Red Algae <i>Kappaphycus Alvarezii</i> (Schimitz) on the Saurashtra Region at West Coast of India	2009	Fisheries Research Station, Okha
56	12016-00	Establishment of Aqua-Based Research and Training Centre in Coastal Saurashtra at Mahuva	2011	Agricultural Research Station (FC), Mahuva
57	12031-00	Crop Improvement in Papaya at Junagadh	2014	Dept. of Horticulture, Junagadh
58	12032-00	Integrated Pest Management in Seed Spices at Junagadh	2014	Dept. of Entomology, Junagadh

(B) Non-plan Scheme (Sponsored by State Government of Gujarat)

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



No.	Budget Head	Name of Program	Sanction Year	Location
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
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, JamKhambhalia
			1964	Dry Farming Res. Stat., Vallbhipur
			2011	Cotton Res. Stat., JAU, Kukada
			1975	Grassland & Agril. Res. Stat., 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

No.	Budget Head	Name of Program	Sanction Year	Location
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 Action Committee (ZREAC)

This committee is functioning at Zonal level of South Saurashtra and 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 new



During the year 2021-22, four meetings of ZREAC were organized; two each at Junagadh and Targhadia. **In the ZREAC meetings, two crop varieties; 35 farmers' recommendations; 25 scientific**

project as well as recommendation. In this meeting, scientists from different disciplines as well as officers from line departments participate and discuss on the results of the projects as well as suggest necessary improvement in new technical programs for future research work. The officers from the line departments are also present feedback as well as overall agriculture situations. They also suggest the inputs for new area of research. It is the multidisciplinary task to evaluate the research results of different disciplines.



recommendations and 69 new technical programs were approved (Table 4.2.2). The feedbacks as well as suggestions were also received from the officers of line departments and KVKs.

**Table 4.2.2 : Zonal Research Extension Action Committee (ZREAC) meeting**

Meeting	Place	Date	No. of Recommendations approved		New Technical Programs
			Farmers	Scientific	
35 th ZREAC (<i>Rabi-summer</i>) of South Saurashtra Agro-climatic Zone	Junagadh	October 20-21, 2021	01*+14	07	28
35 th ZREAC (<i>Rabi-summer</i>) of North Saurashtra Agro-climatic Zone	Targhadia	October 22, 2021	01	-	02
36 th ZREAC (<i>kharif</i>) of South Saurashtra Agro-climatic Zone	Junagadh	January 18-19, 2022	16	16	32
36 th ZREAC (<i>kharif</i>) of North Saurashtra Agro-climatic Zone	Targhadia	January 21, 2022	01*+04	02	07
Total			02*+35	25	69

*No. of crop varieties released.

Agricultural Research Sub Committee (AGRESCO – Discipline-wise)

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

Table 4.2.3 : Agricultural Research Sub Committees

Sub Committee	Subject areas of Research
Crop Improvement	Development of variety and maintenance of germplasm of mandate crops of the region
Crop Production	Agronomy, Agricultural Chemistry & Soil Science, Weed Control
Plant Protection	Entomology & Plant Pathology
Horticulture	Fruits Science, Vegetables Science, Floriculture & Landscape Architecture, Post-Harvest Technology
Agricultural Engineering	Soil & Water Conservation Engineering, Farm Machinery & Power Engineering, Renewable Energy Engineering, Processing & Food Engineering, Irrigation & Drainage Engineering
Animal Science	Animal Breeding, Animal Nutrition, Livestock Production & Management, Anatomy, Medicine & Surgery, Animal Genetics <i>etc.</i> Fisheries Resource Management, Post-harvest Technology, Aquatic Environment, Aquaculture, Fishery Hydrology and Fishery Engineering,
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



Various Agricultural Research Sub Committee meetings were held during February to March 2022 at Junagadh. **Four new crop varieties, 37 farmers' recommendations, 35 scientific recommendations**

recommendations for farmers and scientific community. The scientists presenting the results of various schemes/ projects will refine the reports, recommendations and new technical programs for next season. The suggestions made in the meetings are incorporated in the reports. Each and every proposal and program pertaining to the various disciplines are discussed critically. The conveners of various sub committees present the proceedings in the Joint AGRESKO meeting.



and 65 new technical programs were approved. The reports of the work carried out at various research schemes of the university were also presented and approved.

Table 4.2.4 : Various AGRESKO (Discipline wise) subcommittee meetings organized

Sub Committee	Date	No. of Recommendations		New Technical Programs	On-going Research Projects
		Farmers	Scientific		
Social Science	February 08, 2022	-	04	08	18
Basic Science	February 10-11, 2022	01	07	04	30
Animal Science	February 15-16, 2022	07	08	06	14
Agricultural Engineering	February 17-18, 2022	07	04	06	32
Plant Protection	February 24-25, 2022	04	05	17	-
Crop Production	March 02-03, 2022	14	05	19	138
Crop Improvement	March 04-05, 2022	04*	01	02	42
Horticulture	March 09, 2022	04	01	03	25
		04*+37	35	65	299

*No. of crop varieties released



Joint Agricultural Research Sub Committee (JointAGRESKO)

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



The 18th Joint AGRESKO meeting of JAU was held at College of Agriculture, JAU, Junagadh on March 22, 2022 under the chairmanship of Prof. (Dr.) N. K. Gontia, Hon'ble Vice Chancellor, JAU, Junagadh. All AGRESKO conveners of various committees presented their reports and approved. **Four new crop varieties; 36 farmers' recommendations; 33 scientific recommendations and 66 new technical programs were approved in the meeting.**



disciplines, representatives of line departments *etc.* finalize the programs. The conveners of various AGRESKO present the findings of their respective committees for approval. This committee meeting is presided over by the Hon'ble Vice Chancellor. Joint AGRESKO finalized the recommendations and new technical programs for research, which were presented in the 18th Combined Joint AGRESKO of State Agricultural Universities.



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 Chancellor, 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 presented the reports of their respective universities. In the concluding session, the conveners from each subcommittee presented 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 18th Combined Meeting of Agricultural Research Council (AGRESCO-2021) of SAUs and Kamdhenu University was held through virtual mode, organized and hosted by Junagadh Agricultural

University, Junagadh during May 04-18, 2022. Shri Raghavjibhai Patel, Hon'ble Minister, Agriculture, Animal Husbandry and Cow Breeding, GoG graced the plenary session. Hon'ble Vice Chancellors of JAU, AAU, NAU, SDAU and KU namely Prof. (Dr.) N. K. Gontia, Dr. K. B. Kathiria, Dr. Z. P. Patel, Dr. R. M. Chauhan and Dr. N. H. Kelawala were remained present during the meeting.

During 18th Combined AGRESCO meeting, four new crop varieties viz. Groundnut (GG 39), Indian Bean (GIB-3), Soybean (G.Soy 4) and Cotton (G.Cot.Hy.26-BG-II) of JAU were recommended for release in the state. Besides, 34 technologies/recommendations were made for farmers and 29 recommendations were made for scientific community. In addition, as many as 56 new technical programs were finalized to initiate the new research programs for the solutions of the applied and basic problems of agriculture and allied fields.

Table 4.2.5 : 18th Combined AGRESCO meeting of SAUs

Sub Committee	No. of Recommendations		New Technical Programs
	Farmers	Scientific	
Crop Improvement	04*	-	01
Crop Production	14	04	13
Plant Protection	04	05	15
Horticulture & Forestry	03	-	04
Agricultural Engineering	07	04	06
Animal Science	06	08	06
Basic Science	-	06	04
Social Science	-	02	07
Total	04*+34	29	56

*No. of crop varieties released

All India Coordinated Research Projects (AICRP)

Apart from the mechanism of evaluating and monitoring the research programs / schemes at university level; the projects sanctioned by ICAR, the annual workshop and review meetings in different universities of India are being organized. Twenty 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 Res. Station, Amreli	October 04, 2021	Dr. S. R. Ramgiry, Principal Sci., RVSKVV, R.A.K. College of Agri., Sehore, M.P.
AICRP on Groundnut	Main Oilseeds Res. Station, Junagadh	October 04, 2021 (Online Mode)	1. Dr. P. B. Singh, Scientist (Pl. Br.), MPAUT, Udaipur 2. Dr. G. Harish, Scientist (Ento.) and Dr. Kona Praveen, Sci. (Pl. Br.) ICAR-DGR, Junagadh
AICRP on Cotton	Cotton Research Station, Junagadh	November 26-28, 2021	1. Dr. S. K. Sain, Principal Scientist and Dr. S. K. Verma, Principal Scientist & Head I/c, ICAR-CICR, RS, Sirsa 2. Dr. Kulvir Singh, Principal Scientist (Agronomy), PAU, RRS, Faridkot 3. Dr. S. G. Hanchinal (Ento.), UAS, Raichur 4. Dr. Kannan, Messers Rasi Seeds
	Agricultural Research Station, Amreli		
AICRP on Castor	Main Oilseeds Res. Station, Junagadh	December 15-20, 2021 (On Line Mode)	1. Dr. C. Lavanya, Principal Scientist and Dr. T. Manjunathan, Sci., ICAR- IIOR, Hyderabad 2. Dr. G. Madhuri (Ento.) and Dr. V. Divya Rani (Patho.), RARS, PJTSAU, Palem 3. Dr. P. Kathirvelan, Agronomist, ICRS, TNAU, Yethapur
AICRP on Wheat	Wheat Research Station, Junagadh	February 22-23, 2022	1. Dr. Hanif Khan, Senior Scientist (GPB), IIWBR, Karnal 2. Dr. J. M. Patel, Senior Scientist (GPB), WRS, SDAU, Vijapur 3. Dr. T. L. Prakash, Scientist, IARI Regional Station, Indore 4. Dr. Dinesh Pandey, Scientist, IGKV Research Station, Bilaspur
	Agricultural Research Station, Amreli		
AICRP on PEASEM	Dept. of Renewable Energy Engg., CAET, Junagadh	March 14-17, 2022	Dr. R. K. Singh, Project Co-ordinator, AICRP on Plastic Engg. in Agri. Structure and Environment Management, Ludhiana (Punjab)

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

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	2008-1 (SM)	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
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 germplasm unit	2009	Cattle Breeding Farm, Junagadh
20	2303-09	Gir data recording unit	2009	Cattle Breeding Farm, Junagadh

External Funded Research Projects

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

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

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

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		
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



No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
15	2002-5	Implementation of protection of plant varieties and farmer's rights legislation	2002	ICAR-Network	Main Pearl millet Res. Station, Jamnagar
16	2004-1	Project for frontline demonstration in wheat		ICAR-Network	Wheat Research Station, Junagadh
17	2008-3	Project for frontline demonstration in sesame	2007	ICAR-Network	Agriculture Research Station, Amreli
18	2008-12	Scheme for breeder seed production of oilseeds crops (ICAR revolving fund)	2007	ICAR-Network	Main Oilseed Research Station, Junagadh
19	2009-6	Front line demonstration on cotton	2001	ICAR-Network	Cotton Research Station, Junagadh
20	2254	Study storage losses of food grains	2013	ICAR-Network	Dept. of PFE, CAET, Junagadh
21	2374-1	FLD on Chickpea	-	ICAR-Network	Pulses Research Station, Junagadh
22	2374-6	FLD on Pigeon pea			
23	2504-00	Revolving fund horticulture (Nursery)	-	ICAR-Network	Dept. of Horticulture, Junagadh
24	2704-40	Project for frontline demonstration on groundnut	1999	ICAR-Network	Main Oilseed Res. Station, Junagadh/ Agril. Research Station, Amreli
25	2704-43	Project for frontline demonstration in pearl millet	1989	ICAR-Network	Main Pearl millet Research Station, Jamnagar
26	2002-07	Consortia research platform (CRP) on biofortification	2014		
27	18132	Creation of seed-hubs for increasing indigenous production of pulses in India	2016	ICAR-Network	Dept. of Seed Science & Tech., Junagadh
28	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
29	18009-33	Proliferation of Bt-gene in native cotton varieties of Gujarat	2017	GOG	Cotton Research Station, Junagadh
30	2009-09	Testing of Bt. Cotton	2017	ICAR	Cotton Res. Stat., Junagadh
31	18246-91	River flow simulations integrating satellite data in forested catchment	2017	GOG	CAET, JAU, Junagadh
32	18009-34	Seed infrastructure under NMOOP	2017	GOG	Agril. Res. Station, Amreli



No.	Budget Head	Scheme Name	Sanction Year	Sponsoring Agency	Location
33	1855-03	Mapping and valuation of economics, social and environmental benefits of conserving Gir Forest area	2018	GOG	Dept. of Economics, JAU, Junagadh
34	2009-07	Insecticide Resistance Management: Dissemination of pink bollworm management strategies	2018	ICAR	Cotton Research Station, JAU, Junagadh
35	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
36	2008-08	Project for production of breeder seed of annual oilseeds crops.	1987	ICAR	Main Oilseed Research Station, JAU, Junagadh
37	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
38	2008-19	Mainstreaming of Sesame germplasm for productivity enhancement through genomics assisted core development and trait discovery	2020	ICAR	Agricultural Research Station, JAU, Amreli
39	18247-35	Product testing for pesticides residue to promote organic farming and export of Agricultural produce (RKVY)	2019	GoG	Dept. of Biotechnology, JAU, Junagadh
40	18247-36	Seed Replacement Rate Enhancement for the year 2019-20 (RKVY)	2019	GoG	Dept. of Seed Science & Tech., JAU, Junagadh
41	18274-37	Centre of Excellence for quality testing of cotton (RKVY)	2019	GoG	Cotton Research Station, JAU, Junagadh
42	18247-39	Production of value added cow based by product to sustain Gaushalas (RKVY)	2019	GoG	Cattle Breeding Farm, JAU, Junagadh
43	18247-41	Commercial Exploitation of Date palm through Tissue culture	2019	GoG	Dept. of Genetics & Plant Breeding, JAU, Junagadh
44	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 were produced to fulfill the demand of public and private

sectors as per the national and state indents under coordination of 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

No.	Crop	Variety	Nucleus Seed (q)	Breeder Seed (q)		Total (q)
				National	State	
1	Groundnut	GG-2	3.60	-	44.70	48.30
		GG-5	3.50	-	30.00	33.50
		GG-7	3.20	15.10	10.20	28.50
		GG-8	3.60	-	-	3.60
		GJG-9	15.55	200.10	150.00	365.65
		GJG-31	12.30	75.00	65.10	152.40
		GJG-32	100.00	1000.20	3325.50	4425.70
		GJG-33	2.10	10.20	29.10	41.40
		GAUG-10	5.70	50.10	20.10	75.90
		GG-11	9.00	-	144.00	153.00
		GG-16	3.60	-	-	3.60
		GJG-17	6.00	-	278.10	284.10
		GJG-18	2.10	1.20	9.00	12.30
		GJG-19	5.00	-	0.00	5.00
		GG-20	90.20	70.10	870.00	1030.30
		GG-21	3.00	0.00	13.20	16.20
		GJG-22	160.27	400.20	1678.80	2239.27
		GG-23	5.80	-	-	5.80
		GG-35	9.80	-	-	9.80
		GJG HPS-1	2.80	-	23.10	25.90
		GJG HPS-2	1.75	53.10	10.20	65.05
		GG-37	9.90	0.00	21.10	31.00
		SB-XI	0.06	0.00	0.00	0.06
J-87	0.30	0.00	0.00	0.30		
GJG-41	4.20	-	12.00	16.20		
	Sub Total	463.33	1875.30	6734.20	9072.83	



No.	Crop	Variety	Nucleus Seed (q)	Breeder Seed (q)		Total (q)
				National	State	
2	Pearl millet	GHB 558	-	0.06	0.55	0.61
		GHB 538	-	0.08	6.79	6.87
		GHB 744	-	0.04	2.28	2.32
		GHB 732	-	0.02	5.79	5.81
		GHB 905	-	0.12	3.77	3.89
		GHB 1129	-	-	0.46	0.46
		GHB 1225	-	-	0.75	0.75
		Sub Total	-	0.32	20.39	20.71
3	Sesame	G. Til-1	0.05	-	-	0.05
		G. Til-2	0.50	-	-	0.50
		G. Til-3	0.30	-	3.30	3.60
		G. Til-4	0.30	1.45	1.87	3.62
		GJT-5	0.30	0.95	1.00	2.25
		G. Til-6	0.30	2.20	7.75	10.25
		G. Til-10	0.10	-	1.20	1.30
		Sub Total	1.85	4.60	15.12	21.57
4	Chickpea	GG 1	0.08	-	9.00	9.08
		GG 2	1.50	-	15.50	17
		GJG 3	6.15	-	16.50	22.65
		GG 4	-	-	-	0
		GG 5	6.01	86.00	88.25	180.26
		GJG 6	1.42	30.75	30.75	62.92
		Sub Total	15.16	116.75	160.00	291.91
5	Pigeon pea	GJP 1	0.13	0.25	10.25	10.63
		Sub Total	0.13	0.25	10.25	10.63
6	Wheat	GW 366	2.80	40.00	18.45	61.25
		GJW463	2.60	25.20	45.00	72.80
		GW 496	-	-	33.20	33.20
		Lok 1	-	-	30.00	30.00
		Sub Total	5.40	65.20	126.65	197.25
		Grand total	485.87	2062.42	7066.61	9614.90

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 'Gir Sawaj' brand truthful, foundation and certified seeds of field crops under mega- seed and Seed Hub projects

No.	Crops	Production (q)		
		Truthful	Foundation	Certified
1	Groundnut	481.75	399.50	2132.95
2	Chickpea	574.70	50.40	1092.80
3	Sesame	22.39	-	-
4	Wheat	1545.00	51.20	164.80
5	Cotton	46.00	-	-
6	Castor	30.00	-	-
7	Cumin	9.80	-	-
8	Coriander	30.00	-	-
9	Soybean	134.16	-	-
10	Mungbean	4.50	-	-
11	Urdbean	28.11	-	-
12	Pigeon pea	195.00	12.80	172.00
13	Sugarcane Setts	1000.00	-	-
14	Sorghum	10.98	-	-
	Total	4112.39	513.9	3562.55
	Grand Total	8188.84		

New crop varieties

Four new crop varieties viz. Groundnut (GG 39), Indian Bean (GIB 3), Soybean (G.Soy 4) and Cotton (G.Cot.Hy.26-BG-II) were recommended for farmers during the year 2020-21.

Groundnut variety: Gujarat Groundnut 39 (GG 39: Sorath Uttam)

The farmers of Gujarat state growing groundnut during *kharif* season are recommended to grow Spanish bunch high oleic groundnut variety Gujarat Groundnut 39 (GG 39: Sorath Uttam). This variety has recorded mean pod yield of 2619 kg/ha, which was 34.43, 11.74 and 2.24 per cent higher than the check varieties, GJG 9 (1949 kg/ha), TG 37A (2248 kg/ha) and GJG 32 (2489 kg/ha), respectively. This variety has also recorded higher kernel yield, oil yield and oleic acid (>79 %) than the check varieties. Stem rot disease was lower in GG 39, while tikka, rust and collar rot diseases were comparable to the check varieties. The infestation due to leaf defoliators was lower than the check varieties.



Indian bean variety: Gujarat Indian Bean 3 (GIB 3: Sorath Harita)

The farmers of Gujarat state except South Gujarat growing Indian bean (Papdi) crop during late *kharif* *rabi* season are recommended to grow Indian bean (Papdi) variety Gujarat Indian Bean 3 (GIB 3: Sorath Harita). It has recorded the mean green pod yield of 225.24 q/ha, which was 13.96, and 12.81 per cent higher over local check varieties; Gujarat Papdi-1 (197.65 q/ha) and GJIB 2 (148.85 q/ha), respectively. The pods of GIB 3 are medium long in size with whitish green colour. This variety contains higher

protein content. This variety has cluster pod bearing habit hence, it is suitable for easy pod picking. It is moderately resistance against leaf spot, mosaic diseases whereas, pod borer damage was found low as compared to check varieties.



Soybean variety: Gujarat Soybean 4 (G.Soy 4: Sorath Sonali)

The farmers of Gujarat state growing soybean during *kharif* season are recommended to grow soybean variety Gujarat Soybean 4 (G.Soy 4: Sorath Sonali). This variety has recorded mean seed yield of 2160 kg/ha, which was 11.46, 43.05 and 9.87 per cent higher over the check varieties, JS 335 (1938 kg/ha), G.Soy 2 (1510 kg/ha) and GJS 3 (1966 kg/ha), respectively. This variety has also recorded 10.38 per cent high oil yield over the check variety GJS 3. This variety was found comparable to the check varieties against *Rhizoctonia* root rot and *Cercospora* leaf spot diseases. The damage due to sucking pest and leaf defoliators was also comparable in G.Soy 4 to the check varieties.



Endorsement of Bt Cotton hybrid: Gujarat Cotton Hybrid-26 BG-II (G.Cot.Hy-26 BG-II: Sorath Swet Kanchan)

The farmers of Gujarat state growing Bt cotton hybrid (*Gossypium hirsutum* L.) are recommended to grow cotton hybrid Gujarat Cotton Hybrid-26 BG-II (G.Cot.Hy-26 BG-II: Sorath Swet Kanchan) under

irrigated condition. This hybrid has recorded a 2798 kg/ha seed cotton yield, which was 1.8, 39.7, 21.0 and 5.4 per cent higher over BG-II check hybrids *viz.*, GTHH-49 (2806 kg/ha), RCH-2 (2045 kg/ha), MRC-7351 (2255 kg/ha) and PCH-4599 (2589 kg/ha), respectively. This hybrid gave lint yield of 997 kg/ha, which was 1.1, 48.5, 28.1 and 12.0 per cent higher over BG-II check hybrids GTHH-49 (999 kg/ha), RCH-2 (680 kg/ha), MRC-7351 (767 kg/ha) and PCH-4599 (877 kg/ha), respectively. It possesses 35.3 per cent ginning outturn. This hybrid is medium in maturity. It is found resistant to alternaria leaf spot and bacterial leaf blight diseases and found moderately tolerant against sucking pests.



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 and Irrigation Water Sample

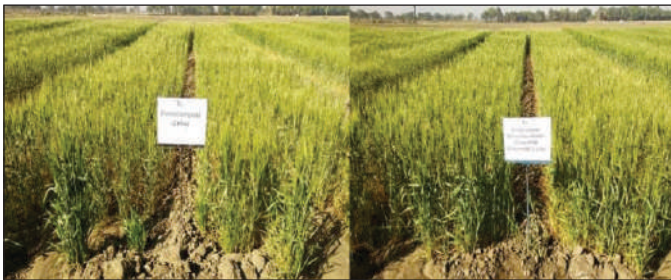
No.	Detail	No. of Sample analyzed
1	Soil sample analysis	2535
2	Irrigation water analysis	1639
3	Plant sample analysis	20082
	Total	24256

Recommendation for Farmers

Nutrient Management

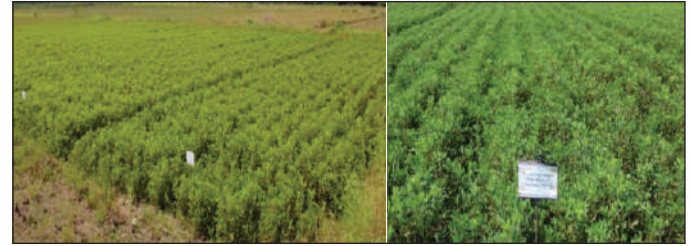
Development and evaluation of microbial consortia enriched vermicompost formulation in wheat

The farmers of South Saurashtra Agro-climatic Zone growing wheat organically are recommended to apply FYM 5 t/ha along with vermicompost 2 t/ha enriched with *Azotobacter* (2 L), PSB (2 L), KSB (2 L), *Trichoderma harzianum* (3 kg), *Pseudomonas fluorescens* (3 L) and *Beauveria bassiana* (3 kg) to obtain higher yield and net return as well as to improve soil health. For enrichment of vermicompost, *Azotobacter* (2 L), PSB (2 L), KSB (2 L), *Trichoderma harzianum* (3 kg), *Pseudomonas fluorescens* (3 L) and *Beauveria bassiana* (3 kg) should be mixed with vermicompost 2 tonne with little water sprinkled (Moisture content 20 %) and apply 10 days after incubation in the field.



Evaluation of microbial consortia enriched vermicompost in *kharif* groundnut

The farmers of South Saurashtra Agro-climatic zone growing *kharif* groundnut organically are recommended to apply FYM 5 t/ha along with vermicompost 2 t/ha enriched with *Rhizobium* (2 L), PSB (2 L), KSB (2 L), *Trichoderma harzianum* (3 kg), *Pseudomonas fluorescens* (3 L) and *Beauveria bassiana* (3 kg) to obtain higher yield and net return as well as to improve soil health. For enrichment of vermicompost, *Rhizobium* (2 L), PSB (2 L), KSB (2 L), *Trichoderma harzianum* (3 kg), *Pseudomonas fluorescens* (3 L) and *Beauveria bassiana* (3 kg) should be mixed with vermicompost 2 tonne with little water sprinkled (Moisture content 20 %) and apply 10 days after incubation in the field.



Effect of different management practices on yellowing and yield of pre-monsoon groundnut

The farmers of South Saurashtra Agro-climatic Zone growing pre-monsoon groundnut (last week of May) are recommended to apply foliar spray of 0.5 % FeSO₄ heptahydrate (50 g/10 L water) with 0.05 % citric acid at 25 DAS and 1 % FeSO₄ heptahydrate (100 g/10 L water) with 0.1 % citric acid at 35 and 45 DAS or foliar spray of 0.5 % FeSO₄ heptahydrate (50 g/10 L water) with 1 % cow urine at 25 DAS and 1 % FeSO₄ heptahydrate (100 g/10 L water) with 2 % cow urine at 35 and 45 DAS or foliar spray of 1.0 % micronutrient mixture grade IV at 45 and 60 DAS in addition to recommended dose of NPK fertilizers (12.5-25-50 N-P₂O₅-K₂O kg/ha) to obtain higher yield, net return and reduction in yellowness.



Identifying suitable crop geometry and nutrient dose for Spanish bunch *kharif* groundnut

The farmers of South Saurashtra Agro-climatic Zone growing bunch groundnut (GJG 32) during *kharif* season are recommended to sow at spacing of 30 cm x 10 cm and apply 100 % RDF (12.5-25-50 kg N-P₂O₅-K₂O/ha) + Biofertilizer [*Rhizobium* (*Rhizobium leguminosarum* and *Rhizobium meliloti* 1 x 10⁷ cfu/ml)] @ 15 ml/kg seed; PSM (*Bacillus subtilis* 1 x 10⁸ cfu/ml) & KMB (*Frateruria aurantia* 1 x 10⁸ cfu/ml) soil application each @ 3 L/ha) as a basal for obtaining higher yield and net return.



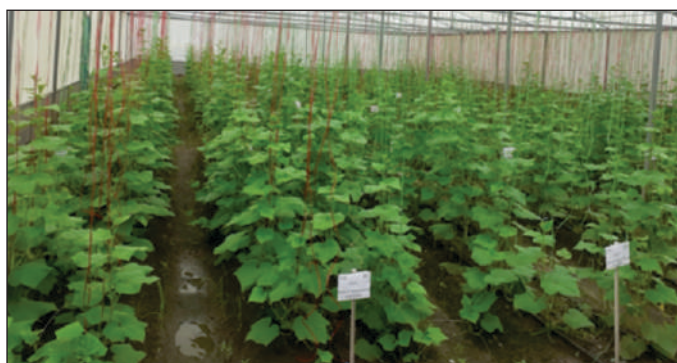
Effect of nano boron on yield and nutrients uptake by summer groundnut

The farmers of Saurashtra region growing summer groundnut in medium black calcareous soil are recommended to apply three sprays of 0.2 % (20 ml/10 L water) nano boron OR 0.2 % (20 g/10 L water) boric acid at 30, 45 and 60 DAS in addition to recommended dose of fertilizer (25-50-50 N-P₂O₅-K₂O kg/ha) to obtain higher yield and net return.



Effect of different levels of NPK and time of application on cucumber yield under protected condition

The farmers of Gujarat growing cucumber during *kharif* season under protected condition (Poly house) are recommended to apply 50-50-50 N-P₂O₅-K₂O kg/ha in form of water soluble fertilizer (19-19-19) and 30 kg/ha nitrogen in form of urea through fertigation in four equal splits *i.e.* basal, 30, 45 and 60 DAS along with *Azotobacter*, PSB and KSB @ 3 L/ha each through drenching to obtain higher yield and net return.



Integrated management practices in groundnut under poorly drained medium black calcareous soil

The farmers of South Saurashtra Agro-climatic Zone growing *kharif* groundnut under poorly drained medium black calcareous soil are recommended to apply *tanch* 50 t/ha or FYM @ 10 t/ha to obtain higher yield and net return.



Nutrient management in Bt. cotton under rainfed condition (Kukada)

The farmers of North Saurashtra Agro-climatic Zone (AES-VI) growing Bt. cotton are recommended to apply 100-30-60 N-P₂O₅-K₂O kg/ha for obtaining higher yield and net return as well as sustaining soil fertility under rainfed conditions. The phosphorus and potash should be applied as basal, while nitrogen should be applied in three splits *i.e.* 25 % as basal at the time of sowing, 50 and 25 % as top dressing at 35-40 and 60-65 days after sowing, respectively by drilling in 10 cm soil depth.



Cultural Practices

Response of *rabi* castor based intercropping systems to drip irrigation

The farmers of South Saurashtra Agro-climatic Zone growing *rabi* castor based intercropping system are recommended to irrigate the castor and intercrops

System details:

Details	Operating Time	
	Month	Minutes
Lateral spacing: 60 cm	November	270
Dripper spacing: 40 cm	December	
Dripper discharge rate: 4 lph	January	216
Operating pressure: 1.2 kg/cm ²	February	
Operating frequency: Alternate day	March	300

Evaluation of land configuration and intercropping system in Bt. Cotton

The farmers of South Saurashtra Agro-climatic Zone adopting Bt. cotton based intercropping system are recommended to sow cotton under broad bed and furrow system (Broad bed 210 cm wide, furrow 30 cm wide & 20 cm deep) to obtain higher seed cotton equivalent yield and net return along with soil moisture conservation. The farmers are also recommended to sow cotton + green gram or black gram in 1:2 row ratio for getting higher seed cotton equivalent yield and net realization.



Productivity of different medium duration pigeon pea varieties under different row spacing

The farmers of South Saurashtra Agro-climatic Zone, growing *kharif* pigeon pea are recommended to

through drip irrigation at 0.8 PEF to obtain higher castor seed equivalent yield and net realization along with higher WUE. Farmers are also recommended to sow gram as an intercrop with *rabi* castor sown at 180 cm spacing in 1:3 row proportion to obtain higher castor seed equivalent yield and net realization.

grow medium duration pigeon pea variety GJP 1 with spacing of 120 cm x 25 cm to obtain higher seed yield and net realization.



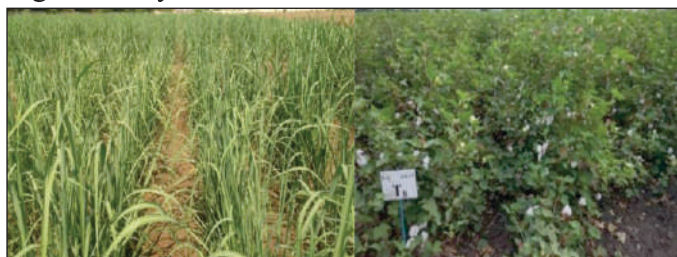
Reduction of chemical fertilizer by using biofertilizers and enriched compost in cotton crop

The farmers of South Saurashtra Agro-climatic Zone growing Bt. cotton are recommended that to obtain higher yield and net realization as well as saving 25 % fertilizer, apply 75 % RDF (180-37.5-112.5 N-P₂O₅-K₂O kg/ha) along with *Azotobacter* + PSB + KSB each 3 L or Consortia (Bio NPK 5 x 10⁸ cfu/ml) 1 L/ha. Full dose of phosphorus as basal, potash in two equal splits as basal and 30 DAS and nitrogen should be given in four equal splits *i.e.* as basal, 30, 60 and 90 DAS.



Ratoon management in sugarcane

The farmers of South Saurashtra Agro-climatic Zone growing sugarcane first ratoon crop are recommended to adopt stubble shaving (Shaving of stubbles above the ground level), off barring (by bullock drawn cultivator and blade harrow) and gap filling (Filling the gaps 60 cm or more) to obtain higher cane yield and net return.



Irrigation Management

Performance of sesame cultivars/ genotypes under different levels of irrigation during summer season

The farmers of Saurashtra region growing sesame during summer season are recommended to grow sesame variety GJT 5 and apply total 12 irrigations scheduled as: first irrigation immediately after sowing, second irrigation at 21 days after sowing and remaining irrigation at 5 to 6 days interval during March-April and 4 to 5 days interval during May (1.0 IW:CPE) to obtain higher seed yield and net return.

Recommendation for Scientific Community

Evaluation of cowpea varieties for salinity tolerance

It is informed to the scientific community especially plant breeders that cowpea variety GC 1 recorded superior values of different salt tolerance



criteria like higher mean salinity index (81.07 %), higher mean seed yield (15.81 g/plant), minimum yield decline (29.1 %) at 8.0 dS/m and for 50 % yield reduction at EC 7.68 dS/m as well as lower Na/K ratio in seed and stalk. Cowpea variety GC 1 was found more salt tolerance as compared to AVC 1, Pusa Falguni and GC 2 on the basis of salinity indices.

Effect of saline irrigation water on pearl millet

It is informed to the scientific community especially plant breeder that pearl millet hybrid GHB 1129 recorded superior values of different salt tolerance criteria like higher mean salinity index (79.25 %), higher mean grain yield (504.0 g/plot), minimum yield decline (32.49 %) at 8.0 dS/m and for 50 % yield reduction at 11.21 dS/m, as well as lower Na/K ratio in grain and fodder. Pearl millet hybrid GHB 1129 was found more salt tolerant as compared to GHB 538, GHB 732 and GHB 558 on the basis of salinity indices.



Periodical evaluation of soil fertility status of Saurashtra region

It is informed to scientific community that, in periodical soil survey of third decade started from 1990, the range and mean value of physico-chemical properties of Saurashtra soil survey (2020) are as below;

Year	pH	EC (dS/m)	CaCO ₃ (g/kg)	CEC [cmol (P+)/kg]	Clay (%)	ESP (%)
1990	7.5-8.9 (8.4)	0.10-1.65 (0.42)	2.0-50.0 (15.86)	15.9-84.4 (40.12)	9.76-67.91 (36.20)	1.64-47.62 (8.25)
2020	6.95-8.90 (7.92)	0.12-2.82 (0.60)	9.6-181.8 (38.8)	7.17-47.10 (24.56)	12.25-65.36 (37.63)	1.31-19.65 (7.36)

Year	OC (%)	Avail. N (kg/ha)	Avail. P ₂ O ₅ (kg/ha)	Avail. K ₂ O (kg/ha)	Heat soluble S (ppm)	Avail. Fe (ppm)	Avail. Mn (ppm)	Avail. Zn (ppm)	Avail. Cu (ppm)
1990	0.17-1.20 (0.52)	109.8-376.30 (195)	7.68-184.32 (40.1)	67-1321 (595)	4.7-159.0 (25.6)	0.02-20.14 (3.93)	1.50-33.03 (6.13)	0.01-10.53 (1.29)	0.29-4.50 (1.22)
2020	0.21-0.86 (0.46)	97-442 (260)	4.6-74.9 (32.5)	142-597 (341)	4.3-46.3 (17.7)	0.75-19.9 (5.1)	3.3-33.2 (14.3)	0.20-2.01 (0.78)	0.47-5.50 (1.94)

Nutrient index values for available N, P₂O₅, K₂O and S were 1.50, 1.68, 2.68 and 2.19, respectively. While, nutrient index values for DTPA extractable micronutrients were 1.47, 2.70, 2.07 and 3.00 for Fe, Mn, Zn and Cu, respectively. Based on nutrient index values, the soils of Saurashtra region categorized in low in available N and Fe, medium in available P₂O₅, S and Zn whereas, high in available K₂O, Mn and Cu.

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

While recommending Zn application to *kharif* soybean crop grown in medium black calcareous soils of Saurashtra, STL and government officials of Gujarat should consider the critical limit of Zn 0.55 ppm in soil and 42.44 ppm in soybean plant at 45 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 2021-22, 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 'Gir Sawaj' brand bio-agent and liquid bio-fertilizer

No	Name of Product	Quantity
1	<i>Trichoderma</i> (q)	23.40
2	<i>Rhizobium</i> (liter)	559
3	<i>Azotobacter</i> (liter)	528
4	PSB (liter)	935
5	KMB (liter)	197

Department of Entomology has produced various microbial agents under the trade name *Gir Sawaj*"e.g. viruses, bacteria, fungi, protozoans and nematodes are being used in IPM program as shown in below table. Among viral pathogens, nuclear polyhedrosis viruses of *Helicoverpa* (HNPV), *Spodoptera* (SNPV), entomopathogenic fungi *Beauveria bassiana*, fruit fly trap, fruit fly lure, pheromone trap, pheromone lure are widely used for insect control. These pathogens are highly specific to their host and being considered environmentally safe.

Table 4.5.2 Production of 'Gir Sawaj' brand microbial agents, traps, lure etc.

No.	Name of Product	Quantity
1	<i>Beauveria</i> (q)	34.07
2	<i>Metarhizium</i> (kg)	531
3	HNPV (litre)	151
4	SNPV (litre)	62.5
5	Trichocard (Nos.)	755
6	Fruit fly traps (Nos.)	15166
7	Fruit fly lure for vegetable crops (Nos.)	826
8	Fruit fly lure for fruit crops (Nos.)	22224
9	Pheromone Trap (Nos.)	7888
10	Pheromone Lure (Pink bollworm) (Nos.)	9892
11	Pheromone Lure (<i>Heliothis</i>) (Nos.)	3496

No.	Name of Product	Quantity
12	Pheromone Lure (Brinjal shoot and fruit borer) (Nos.)	708
13	Pheromone Lure (<i>Spodoptera</i>) (Nos.)	1496
14	Pheromone Lure (Fall armyworm) (Nos.)	126
15	MDP Technology for Pink bollworm (100 gm Tube)	546
16	MDP Technology for Brinjal shoot and fruit borer (100 gm Tube)	16
17	Honey (litre)	657
18	Chrysopa eggs (Nos.)	244000

Recommendation for Farmers

Entomology

Bio-efficacy of different biocides against aphid in coriander

The farmers of Gujarat growing coriander are recommended to spray *Beauveria bassiana* 1.15 WP (Min. 1×10^8 cfu/g) 0.007 % (60 g/10 l of water) or *Lecanicillium lecanii* 1.15 WP (Min. 1×10^8 cfu/g) 0.009 % (80 g/10 l of water), first at ETL and subsequent three sprays at 10 days interval for effective and economical management of aphid.



As per CIB RC Format

Year	Crop	Pest	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ha	Application schedule
				a.i./ha	Quantity of formulation Kg or ml/ha	Concen. (%)	Dilution in water (10 lit.)		
2021-22	Coriander	Aphid	<i>Beauveria bassiana</i> 1.15 WP	35	3 kg	0.007	60 g	500 litre	First spray at ETL and subsequent three sprays at 10 days interval after first spray
			<i>Lecanicillium lecanii</i> 1.15 WP	46	4 kg	0.009	80 g		

Bio-efficacy of *Beauveria bassiana* and different insecticides against insect pests of groundnut

The farmers of Gujarat growing *kharif* groundnut are recommended to apply five sprays of bio-pesticide, *Beauveria bassiana* 1.15 WP (Min. 1×10^8 cfu/g), 0.007 % (60 g/10 l of water) at 15 days interval after initiation of any pest infestation for effective and economical management of sucking pests (jassid, aphid and thrips) and leaf eating caterpillars (*H. armigera* and *S. litura*).


As per CIB RC Format

Year	Crop	Pest	Pesticides with formulation	Dosage				Total Qty. of Chemical suspension required/ha	Application schedule
				a.i./ha	Quantity of formulation kg or ml/ha	Conc. (%)	Dilution in water (10 lit.)		
2022	Groundnut	Sucking pests (Jassid, aphid and thrips) and leaf eating caterpillars (<i>H. armigera</i> and <i>S. litura</i>)	<i>Beauveria bassiana</i> 1.15 WP	35	3.0 kg	0.007	60 g	500 litre	First spray at initiation of any pest infestation, subsequent four sprays at 15 day interval after first spray

Management of shoot fly and stem borer infesting pearl millet crop

The farmers of Gujarat growing pearl millet in *kharif* season are recommended to treat seed with imidacloprid 600 FS (8.75 ml/kg) followed by two

sprays at 20 and 40 DAG either *Beauveria bassiana* 1.15 WP (Min. 1×10^8 cfu/g), 0.007 % (60 g/10 l of water) or *Panchgavya* 3 % (300 ml/10 l of water) for effective and economical management of shoot fly and stem borer.

As per CIB RC Format

Year	Crop	Pest	Pesticides with formulation	Dosage				Total qty. of chemical suspension required /ha	Application schedule
				g. a.i./ha	Qty. of formulation g, ml, kg or l/ha	Conc. (%)	Dilution in water (10 lit.)		
2021-2022	Pearl millet (Bajra)	Shoot fly and stem borer	Imidacloprid 600 FS	16.8	35 ml	Seed trt.	--	--	Seed treatment
			<i>B. bassiana</i> 1.15 WP @ 1×10^8 cfu/g	34.5	3.0 kg	0.007	60 g	500 L	Two sprays, 20 & 40 DAG
			<i>Panchgavya</i>	--	15.0 L	3.0	300 ml	500 L	



Plant Pathology

Integrated management of root rot (*macrophomina phaseolina*) of castor

The farmers of Gujarat growing castor are recommended to apply 5 kg *Trichoderma harzianum*

As per CIB &RC Format

Year	Crop	Disease	Pesticides with formulation	Dosage				Application schedule	Remark (s)
				g.a.i./ha	Quantity of formulation g, ml, kg or l/ha	Conc. (%)	Dilution in water (10 lit)		
2022	Castor	Root rot	<i>Trichoderma harzianum</i> 1 % WP	-	5 kg	2 x 10 ⁶ cfu/g	-	As soil application with 500 kg FYM at the time sowing	In Castor crop this bioagent is not registered

Recommendation for Scientific Community

Entomology

Evaluation of ready mix insecticides against groundnut defoliators

Two sprays of chlorantraniliprole 10 % + lambda cyhalothrin 5 %, 15 % ZC @ 0.006 % (4 ml/10 l of water) or novaluron 5.25 % + emamectin benzoate 0.9 %, 6.15 % SC @ 0.009 % (15 ml/10 l of water), at 15 days interval starting from pest infestation, found effective for the management of groundnut defoliators (*Helicoverpa* & *Spodoptera*).

Determination of economic threshold level of bajra stem borer, *Chilo partellus* (Swinhoe)

The 5 % plant damage by stem borer is considered as economic threshold level (ETL) in *kharif* pearl millet.

Integrated management of insect pests and diseases of green gram crop under rainfed condition

Application of two sprays of cartap hydrochloride 50 SP 0.075 % (15 g /10 l water) and hexaconazole 5 SC 0.0075 % (15 ml /10 l water) should be carried out, mixed in spray tank, first at initiation of flowering and second at pod setting for the effective management of pod borer and leaf spot disease of green gram under rainfed condition.

1 % WP (Min. 2 x 10⁶ cfu/g) enriched before one week in 500 kg FYM/ha at the time of sowing for effective and economical management of root rot.

Estimation of yield loss due to semilooper, *Achaea janata* Linnaeus in castor under rainfed condition

The avoidable average yield loss in castor is recorded up to 44 per cent (20 % to 95 %) by semilooper under rainfed condition.

Plant Pathology

Viability of *Trichoderma* under different storage conditions in nitrogen packing and commercial packing

The JAU- isolate *Trichoderma harzianum* remains viable up to 18 months from date of packaging at ambient temperature, at 28°C and in refrigerator at 10°C.

4.6 Horticulture and Forestry

Horticulture and Agro Forestry carry out the research on fruit science, vegetable 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

No.	Planting Material	Production (Nos.)
1	Fruit crop graft	7964
2	Fruit crops saplings	90242
3	Seedlings	35153
4	Ornamentals & Medicinal plants	36995
	Total	170354

Recommendation for Farmers

Effect of biostimulants and micronutrients on growth, flower yield and quality of tuberose (*Polianthes tuberosa* L.) cv. Prajwal

The farmers of Saurashtra region growing tuberose are recommended to apply four foliar spray of *panchgavya* @ 3% (300 ml/10 lit of water) starting from 30, 60, 90 & 120 days after planting and spray of FeSO₄ @ 1 % (100 ml/10 lit. of water) + 0.1 % citric acid (10 ml/10 lit of water) at 45, 75,105,135 days after planting for getting higher yield and net return.



Performance of different grafted variety and mulching in Brinjal

The farmers of Saurashtra region growing brinjal are recommended to use variety GJB3 side grafted on *Solanum torvum* (wild brinjal) with 25 micron silver black mulch for higher yield and net return.



Effect of organic manures, biofertilizers and biostimulants on growth and yield of drumstick (*Moringa oleifera* Lam.) cv. PKM-1

The farmers of South Saurashtra Agro-Climatic Zone growing drumstick are recommended to apply FYM @ 20 kg/plant along with 20:20:20 NPK g/plant as a basal dose during *kharif* and remaining 20g N/plant is given after withdrawal of monsoon for getting higher yield and net return.

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 produce and soil and water conservation *etc.*

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	61
B	Sowing and planting equipment	50
D	Plant protection equipment	22
E	Harvesting and threshing equipment	32
F	Equipment for residue management	12
	Total	177

The “Testing and Training Center of Farm Machinery” under the Department of Farm Machinery and Power Engineering, 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.

Recommendation for Farmers

Design, development and performance evaluation of battery operated pruner for horticultural crops

The farmers are recommended to use the “Battery operated rotary blade pruner for horticultural crops” developed by Junagadh Agricultural University, to prune horticultural crops like Lime, Guava, Jamun and Ornamental crops. The operator can prune in all directions up to height of 4 meters.



Assessment and management planning of groundwater resources of Uben river basin

It is recommended to the farmers, NGOs and Government line departments that 50 % of rainfall as groundwater recharge including natural recharge is required for sustaining water resources in the Uben basin. The optimum groundwater recharge planning of Uben basin should be done by recharging through 2372 check dams, 15751 farm ponds, 5558 open wells and 1390 tube wells.



Impact of irrigation regimes and fertigation scheduling on brinjal crop

Farmers of South Saurashtra Agro climatic Zone growing brinjal crop during *rabi* season are recommended to apply 100 % RDF of phosphorous and 25 % RDF of N and K (100:37.5:37.5 N: P₂O₅: K₂O) as a basal dose and remaining 75 % RDF of N and K through drip irrigation in 7 equal splits after 25 days of transplanting at 12 days interval to obtain higher yield, net return, water use efficiency and save up to 42 % irrigation water compared to furrow irrigation.



Details of drip system	Irrigation scheduling
Lateral spacing : 90 cm Dripper spacing: 60cm Dripper discharge: 4 lph Operating pressure: 1.2 kg/cm ²	At 0.8 ETc with 3 days interval a) November:47 min b) December: 50 min c) January: 1 hr. 15 min d) February: 1 hr. 50 min e) March : 2 hr. 20 min.

Performance evaluation of farm yard manure applicator for wheat crop

Farmers of South Saurashtra Agro-climatic Zone growing wheat are recommended to apply 7.5 t/ha. FYM in furrow in addition to RDF, using Junagadh Agricultural University developed FYM applicator to obtain higher net return and save 25 % of FYM.



Design and development of grain treater for enzymatic pre-treatment to pigeon pea grains

The pulses processors are recommended to use the grain treater (capacity 100 kg/batch of 8 h) developed by Junagadh Agricultural University for efficient enzymatic pre-treatment to increase the hulling efficiency, reduce the processing cost and improve the benefit-cost ratio as compared to the traditional dhal processing.



Low temperature grinding of spices (Turmeric)

The farmers and spice processors are recommended to use Junagadh Agricultural University developed grinding process for turmeric rhizome feed



at low temperature ($-10 \pm 2^{\circ}\text{C}$) using coolant (propylene glycol) circulation (15 lpm) through jacketed grinding mill for better retention of biochemical compounds (including curcumin) and volatile oil.

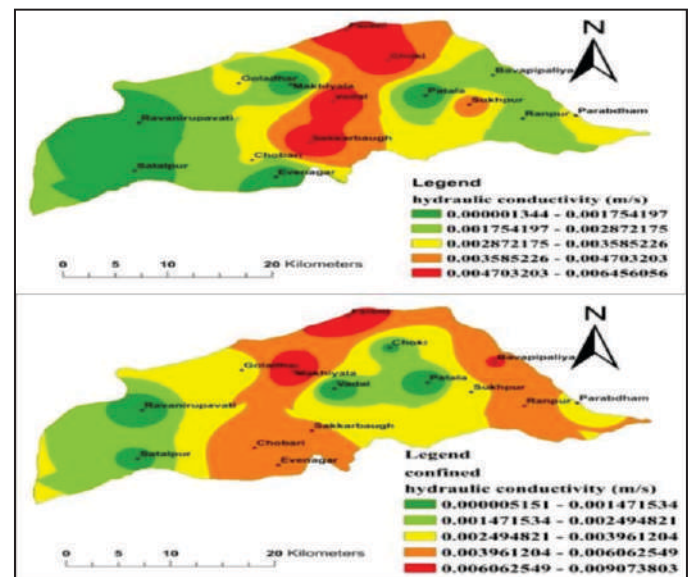
Effect of protected structure and mulching on cauliflower cultivation during rainy season

The farmers of Gujarat are recommended to use Junagadh Agricultural University developed poly-cum-net house for off-season cauliflower cultivation during rainy season to achieve higher crop production and net return.



Recommendation for Scientific Community Assessment and management planning of groundwater resources of Uben river basin

It is recommended to scientific community that the calibrated hydraulic conductivities for confined and unconfined aquifers of Uben river basin determined by electrical resistivity method are as:



Calibrated hydraulic conductivity of Uben basin			
No.	Location	Unconfined Aquifer K (m/s)	Confined Aquifer K (m/s)
1	Sakkarbaugh	0.006482947	0.00387976
2	Sukhpur	0.004538363	0.00363189
3	Ranpur	0.002018549	0.004539113
4	Parabdham	0.0030266	0.0034919
5	Ivnagar	1.00E-04	0.0051875
6	Patala	1.50E-04	3.00E-04
7	Choki	0.0060522	0.001398
8	Vadal	0.0064829	3.00E-04
9	Makhiyala	1.50E-04	0.0090752
10	Chobari	0.0030246	0.0052944
11	Satalpur	0.0013	0.0014
12	Goladhar	0.00303	0.00248
13	Ravani-Rupavati	2.63E-04	0.0009102
14	Fareni	0.0060486	0.0090752
15	Bava-Pipaliya	0.0018163	0.0060512

Root growth study of Brinjal crop under different irrigation methods

The drip designers/ Irrigation water managers /Scientific communities are advised to adopt the following root growth models of exponential model of either Rasmussen and Hanks or Hanks and Hill for Brinjal crop grown in loamy soil as a decision support tool for drip operational parameters to get wetted bulb matching with depth and spreading of root zone. Model efficiency was observed 99.79 %. The maximum number of lateral roots and length of the lateral roots found under drip irrigation with mulch

resulted maximum moisture uptake (56.91 %) from first quarter of root zone (0-25 % from top) at all plant growth stages compared to other irrigation methods.



Root growth model	Horizontal root spreading	Vertical root zone
Rasmussen and Hanks, 1978	$L_t = L_0 + (L_m - L_0) / [1 + \text{Exp}\{A - B(t/t_m)\}]$ Where, A = 0.78 and B = 6.99	$RD_t = RD_0 + (RD_m - RD_0) / [1 + \text{Exp}\{A - B(t/t_m)\}]$ Where, A = 3.25, B = 13.14
Hanks and Hill, 1980; Arora et al., 1987	$L_t = L_m / [1 + \text{Exp}\{a - b(t/t_m)\}]$ Where, a = 0.64, b = 6.81	$RD_t = RD_m / [1 + \text{Exp}\{a - b(t/t_m)\}]$, Where, a = 3.25, b = 13.14

Online university student fees receipt system

It is recommended to use Junagadh Agricultural University developed Web based "Online university student fees receipt system" by the State Agricultural Universities (SAU's) of Gujarat as a part of e-Governance

initiatives in the Universities. It provides seamless digital interface to the students of the various colleges for making digital payment towards their educational fees such as semester fee, hostel fee, etc. and equips the staff for better governance.

Development of online salary bill management for JAU, Junagadh

It is recommended to use Junagadh Agricultural University developed Web based “Online Salary Bill Management” by the State Agricultural Universities (SAUs) of Gujarat as a part of e-Governance initiatives. It is time and paper saving digital interface that provides administratively hierarchical salary bill processing system through which university employees' salary bills can be managed online. This system provides various report generation facilities for the preparation of budget as well as monthly and periodic salary statement of each employee.

4.8 Basic Science

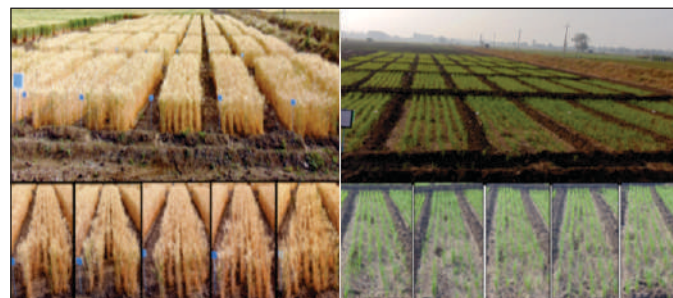
Basic Science group works on the areas of plant Biochemistry & Biotechnology, Plant Physiology and Plant molecular Biology. It includes research on Genetic manipulation of crops for stress resistance, molecular biology and genetic engineering work in plant sciences.

Recommendation for Scientific Community

Development and characterization of polymer based nanofertilizers and their response to wheat

Chitosan nanoparticles (CS-NPs) were synthesized and examined greater than 40 mV zeta potential indicating good stability. The urea, tricalcium phosphate and muriate of potash were used as sources for incorporation of N, P and K elements individually onto the CS-NPs and the elevation of size of the nanofertilizers, without aggregation of nanoparticles, were observed. Scanning electron micrograph illustrated spherical shape of the CS-NPs and gave the idea about the morphology of incorporated NPK nanofertilizers. The FTIR study indicated that there is an electrostatic interaction occurs between the charges of CS-NPs and the NPK elements, resulted to stretching of spectra (peak) at specific wavelength confirming the incorporation of N P and K elements on to the CS-NPs. The application of 5 % NPK nanofertilizers (10 times less) on wheat suggested higher nutritional seed quality and maintained yield equivalent to chemical fertilizers. The cost-effective

NPK-nanofertilizers thus developed may save the forex (subsidy) about 38.22 %. It has better controlled - release system in a liquid formulation to enhance nutrient use efficiency and sustained crop growth.



Biochemical appraisal of enzymatic activities from soils of permanent plot experiment at JAU, Junagadh

The soil enzyme activity studied *viz.*, urease, acid phosphatase, alkaline phosphatase, – Galactosidase and nitrate reductase, from the plot having different fertilizer applications, remains higher during the mid-season and found to be lower before sowing and after harvest of the crop. Minimum variation of enzyme activity was observed in a plot of only FYM treatment (25 tons/ha). The activity of urease, β -Galactosidase and β -glucosidase as well as acid phosphatase and alkaline phosphatase was enhanced by balance fertilizer application (100 % NPK (25:50:50) as per soil test as well as 25 tons/ha FYM application. The pod yield of groundnut was remained highly positively correlated with urease, acid phosphatase and alkaline phosphatase enzyme activity.

Isolation and identification of entomopathogenic microorganisms from the soils of Junagadh district

The Scientific communities involved in microbial and entomological research are recommended to use native identified entomopathogenic microbes including *Pseudomonas putida* (MK415028.1), *P. monteilii* (KT881478.1), *P. knackmussii* (KY324901.1), *P. fulva* (KC293832.1), *Bacillus subtilis* (MH141058.1), *B. thuringiensis* (KY003094.1), *B. clausii* (AB251924.1), *Enterobacter asburiae* (MK 467572.1), *E. cloacae*

(JX514409.1), *Beauveria bassiana* (KC753382.1), *Metarhizium anisopliae* (KJ573520.1) and *Verticillium lecanii* (AJ292383.1) for the production of biofertilizer and biocontrol agent as they suppressed *Helicoverpa armigera*, and have PGPR activity.

Isolation and identification of salt tolerant strains of beneficial microorganisms from the coastal soils of Saurashtra region.

Native halophilic bacterial strains isolated from agricultural soils of coastal regions of Saurashtra have potential for application in both industries and agriculture. The promising performance of these isolates in terms of plant growth promoting characteristics such as nitrogen fixing capacity, solubilization of phosphate and potash, production of IAA, siderophore along with production of biochemically important enzymes and bioactive compounds such as chitinase, cellulase, protease, carotene, ectoine, glycine betaine was observed.

Halophilic bacterial isolates were *Halomonas pacifica* strain_JAU_7B (MK955347), *H. pacifica* strain_JAU_20A (MK575078), *H. pacifica* strain_JAU_22A (MK042491), *H. pacifica* strain_JAU_22C (MK043087), *H. pacifica* strain_JAU_25A (MK116946), *H. pacifica* strain_JAU_29A (MK114047), *H. pacifica* strain_JAU_36A (MK114047), *H. pacifica* strain_JAU_36B (MK114047), *H. stenophila* strain_JAU_37A (MK961217), *Oceanobacillus aidingensis* strain_JAU_39B (MK148253), *H. pacifica* strain_JAU_40B (MK114047), *Bacillus haynesii* strain_JAU_41A (MK157609), *B. licheniformis* strain_JAU_43A (MK118996), *B. haynesii* strain_JAU_43B (MK157608) and *B. haynesii* strain_JAU_45A (MK157609) which confirmed through molecular characterization by 16srRNA.

Diversity analysis of fresh water diatoms through SEM-EDX from surface microalgae of water bodies of Junagadh region

The scientific community involved in diatom study of fresh water in context to climate change and environment are recommended to use cataloguing of

fresh water diatoms collection images from water bodies in and around JAU, Junagadh. Total 46 species of diatoms were identified from water bodies of Junagadh, out of which eleven genera viz., *Cyclotella*, *Melosira*, *Navicula*, *Achnanthes*, *Amphora*, *Synedra*, *Nitzschia*, *Gomphonema*, *Hantzschia*, *Pinnularia* and *Fragillaria* were predominant. The sizeable variation among the elements presents on freshwater algae through SEM EDAX showed the presence of all macro elements except phosphorus and nitrogen. All species of diatoms had higher amount of diversity indices including Shannon-Wiener diversity index (3.57) and Berger Parker Dominance (30.57). Morphometric analysis showed wider variability in location and species wise according to length (7.049 μm to 43.08 μm) and width (2.53 μm to 23.44 μm) as well as diversity indices too. Wellington dam site showed maximum spp. variation of diatoms than the other location.

Evaluation of nano fertilizer in Bt. cotton (*Gossypium hirsutum* L.) under rainfed condition

In the North South Saurashtra Agro-climatic Zone (AES-IV), *Bt.* cotton fertilized with 80:40 N:P₂O₅ kg ha⁻¹ (Nitrogen in three splits i.e. 25 % as basal at the time of sowing and 50 and 25 % as top dressing at 35-40 and 60-65 days after sowing) to *Bt.* cotton recorded higher yield and net realization as well as sustained soil fertility under rainfed condition. Application of nano nitrogen fertilizer as developed by JAU save 60 % conventional fertilizer dose.

4.9 Animal Science

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 the research station has 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 Narsinh 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

No.	Particular	Gir Bulls	Jaffrabadi Bulls
1.	Frozen semen doses available in stock from last year (Nos.)	212480	129359
2.	Frozen Semen doses Produced (Nos.)	22145	13970
3.	Frozen Semen doses used for AI in Field (Nos.)	2495	2770
4.	Frozen Semen doses used for AI on Farm (Nos.)	190	60
5.	Frozen Semen doses sold to AI Workers (Nos.)	755	495
6.	Frozen semen doses in stock (Nos.)	231185	140004
7.	Animals distributed to Grampanchayat, Gaushala, other Institute etc. (Nos.)	35	1

During the year 2021-22, Fisheries Research Station, Sikka has successfully breed- pearl oyster (bivalve) and 30 species of sea slugs. This station has produced 120.95 lakh pearl oyster larvae and reared them up to juvenile stage and from the produced larvae, total 110.00 lakh spat/ juvenile/ larvae has sea ranched to increase their natural population. During the year, sums of 32 species were successfully bred in captive condition at FRS, JAU, Sikka.

Recommendation for Animal Owners/ Dairy Farmers/ Fish Farmers

Animal Health

Clinical study on ultrasonographic morphology of healthy udder and teat in Gir cattle

Udder and teat disorders have major concerns in Gir milch cattle. Ultrasonography is one of the available diagnostic modalities for early and prompt diagnosis of such abnormalities. So, dairy farmers are recommended to visit the Veterinary clinic for the diagnosis of udder and teat disorder with ultrasonography as per the guidance of Veterinarian.

Animal Production

Effect of feeding Moringa (*Moringa oleifera*) based calf starter on the performance of suckling Jaffarabadi buffalo calves

It is recommended to livestock owners rearing Jaffarabadi calves that Moringa leaf powder-based calf starter (46 kg Moringa leaves/100 kg calf starter) can be fed to increase growth rate at lower feed cost.



Composition of calf starter:-

1. Groundnut cake- 10 %
2. Maize – 25 %
3. Skim milk powder- 16 %
4. Moringa leaves- 46 %
5. Salt-1 %
6. Mineral mixture- 2 %

Fisheries Science

Maximum Sustainable Yield (MSY) estimation of fisheries resources of Gujarat coast with Surplus Production Model

This is recommended to the fishermen of Gujarat that Hilsa, Shark, Catfish, Eel, Seer fish and Lobster show signs of over exploitation; hence reduce fishing efforts of these species as they have slow growth rates, low fecundity for their sustainable harvest. The fishing effort can be reduced through increase in mesh size of fishing gear, releasing back brooders in the sea, extensive use of selective fishing gears like gill nets, long-line & traps and expanding fishing ban period voluntarily.

Effect of oral administration of probiotic *Lactobacillus plantarum* on growth, survival, disease resistance and stress tolerance of *Litopenaeus vannamei* juveniles

Shrimp farmers are recommended to incorporate probiotic bacteria *Lactobacillus plantarum* @ 10^7 CFU in one gram feed of shrimp *Penaeus vannamei* for higher growth, survival and resistance against pathogenic *Vibrio harveyi*, reduce ammonia stress and hence increase profit.



Effect of dressing on quality parameters of dry salted Dhoma (*Otolithes cuvieri*) during storage

The dry fish processors/exporters are recommended to remove gill and gut from dry salted Dhoma fish (*Otolithes cuvieri*) packed in plastic bag for better quality and shelf-life up to nine months.

Supplementation of shrimp protein hydrolysate in practical diets of *Litopenaeus vannamei* (Boone, 1931)

Shrimp farmers growing *Penaeus vannamei* juvenile shrimps are recommended to use feed with 2 % shrimp protein hydrolysate at the rate of 5 % of body weight/day for better growth, survival rates and higher economic return.



Recommendation for Scientific Community

Animal Health

Clinical study on Ultrasonographic morphology of healthy udder and teat in Gir cattle

In Gir cattle, ultrasonographic morphology of normal and healthy teat viz., streak canal length, streak canal diameter, teat diameter and teat wall thickness ranges between 3.7 to 4.7, 2.8 to 3.1, 19 to 20 and 4.4 to 5.4 mm, respectively, while normal and healthy udder shows hypoechoic uniform texture with round borders and normal shape. These baseline data of ultrasonographic morphology of healthy udder and teat can be used as reference values for diagnostic and prognostic features to confirm udder and teat abnormalities.

Clinical studies on balanced anesthesia using different anesthetic protocols in horses

Combination of Inj. Butorphanol (0.02 mg/kg BW), Midazolam (0.1 mg/kg BW) and Xylazine (0.8 mg/kg BW) intravenously as preanaesthetics followed by Inj. Ketamine HCl (1.6-2.4 mg/kg BW, IV) induction and Isoflurane (2–3 %) maintenance can be used to produce balanced anaesthesia in horses.

Evaluation of antioxidant and immunomodulatory effect of seeds of *Cassia absus* L. in rats

Daily oral administration of flavonoid rich fraction of *Cassia absus* L. (Chimed) seed at the rate of 200 mg/kg body weight for 21 days alleviates cyclophosphamide-induced immunosuppression and oxidative stress in rats.



Ultrasonography, Uterine Swab Culture and Endometrial Cytology for diagnosis of Equine Endometritis

Ultrasonography along with endometrial cytology is effective diagnostic method for subclinical endometritis in infertile mares.

Animal Production

Efficacy of Artificial Neural Network for milk Prediction in Jaffarabadi buffaloes

First lactation milk yield in Jaffarabadi buffaloes can be predicted using 2nd, 4th, 5th & 6th monthly test day milk records with 77.89 % accuracy. The optimum equation for prediction of FL305DMY using backward elimination method of Multiple Linear Regression is $\hat{Y}=198.69+ (32.77) TD2+ (39.36) TD4 + (45.23) TD5+ (109.31) TD6$. Furthermore, Artificial Neural Network using training and testing ratio of 80:20 with two hidden layers and 5 neurons can be used to predict the first lactation milk yield in Jaffarabadi buffaloes with accuracy of 86.49 percent.

Effect of Feeding Moringa (*Moringa oleifera*) based calf starter on the performance of suckling Jaffarabadi buffalo calves

Moringa leaves (*Moringa oleifera*) are cheaper and economical source of good quality protein (25.19 %) to be used to meet out 50 % protein requirement in the formulation of calf starter to obtain a higher (36 %) growth rate in Jaffarabadi calves.

Fisheries Science

Analysis of condition factor of the ribbonfish *Lepturacanthus savala* and *Trichurus lepturus* off Veraval Coast

Condition factor obtained for *Trichurus lepturus* is 0.092 to 0.205 and 0.073 to 0.159 for male and female respectively. The condition factor obtained for *Lepturacanthus savala* is 0.058 to 0.251 and 0.063 to 0.136 for male and female respectively.

The length-weight relationship obtained for *Trichurus lepturus* is $W=0.000013 L 2.90$ and $W=0.000014 L 2.93$ for male and female respectively. The length-weight relationship obtained for

Lepturacanthus savala is $W=0.000010 L 2.71$ and $W=0.000013 L 2.65$ respectively for male and female.

The Ribbon fish *Trichurus lepturus* and *Lepturacanthus savala* shows similar condition factor and shows allometric growth.

Seed production of mud spiny lobster *Panulirus polyphagus* (Herbst, 1793) in hatchery

Incubation and hatching of eggs and rearing of larvae up to phyllosoma-II stage of high value mud spiny lobster *Panulirus polyphagus* achieved at Fisheries Research Station, JAU, Okha. The average initial egg size was 496.07 μ and incubation period was 25.76 days. The average duration of phyllosoma-I (1525.18 μ) and phyllosoma-II (2239.67 μ) stage were 13.76 and 4.75 days respectively. Looking to its economic importance, further detailed studies are required using advanced hatchery system.

4.10 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 Cucurbitaceae *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 cumin (*Cuminum cyminum* L.) 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 Export cost estimation and mileage of major commodities of



Saurashtra; Business opportunities of exotic vegetables in Saurashtra; Financial Literacy among the students of Junagadh Agricultural University; Value chain analysis of Kesar mango in Saurashtra region; Effect of Micro Irrigation System on Livelihood in Saurashtra Region.

Recommendation for Scientific Community

Analysing India's comparative advantage in world cumin (*Cuminum cyminum* L.) exports: An application of Gravity model

The comparative advantage of India, and particularly Gujarat, can be enhanced in cumin exports and the country can emerge as a price setter in the world cumin trade only when the issues around domestic yield and prices are addressed institutionally. Yield levels should be sustained at lower production costs for reducing export instability through competitive pricing and to cool down domestic prices. Large-scale pre-shipment quality checks and long-term contracts may be facilitated for

better price negotiation. Above all, production and export incentives should also be channelized directly to the cumin farmers for generating a genuine market-driven exportable surplus.

Training needs of farmers with respect to scientific cultivation of cumin crop in Porbandar district

The cumin farmers of Porbandar district with social participation and mass media exposure may be focused for one-day training programs that are arranged continuously over a year in the areas of new variety, ploughing and value addition.

4.11 Transfer of Technology

Front Line Demonstration (FLD) conducted on farmers' field

Crop scientists of JAU have successfully conducted Front Line Demonstrations (FLDs) of newly developed varieties and production technologies on farmers' fields for speedy propagation among the farmers.

Table 4.11.1 Summary of FLDs of Improved Varieties

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	Groundnut (Summer)	GJG 34	15	6	23.07	19.93	15.86
2	Groundnut (<i>Kharif</i>)	GJG 32	44	17.6	21.03	17.61	19.52
3	Castor	GCH 9	36	14.40	34.95	29.95	16.69
4	Sesame (Summer)	GJT 5	3	2.4	10.38	9.14	13.51
5	Sesame (<i>Kharif</i>)	G.Til 4	4	3.20	5.56	4.94	9.92
6	Wheat	GJW 463					
7	Pearl millet (Summer)	GHB 538	10	4.0	35.25	33.46	5.35
		GHB 1129	20	8.0	38.69	35.30	9.62
		GHB 1231	20	8.0	40.05	36.78	8.89
8	Pearl millet (<i>Kharif</i>)	GHB 1231	25	10.0	30.79	26.78	14.98
9	Coriander	Gujarat Coriander-3	19	0.4	13.23	11.68	13.22
10	Garlic	GJG-5	14	0.4	68.20	58.02	17.54
11	Fenugreek	Gujarat Fenugreek-2	4	0.4	18.28	15.85	15.30
12	Okra (<i>Kharif</i>)	Gujarat Okra-6	2	0.4	129.00	107.27	20.26

Table 4.11.2 Summary of FLDs of Improved Technology

No.	Crop / other	Production technology	No. of FLDs	Total area under FLD (ha)	Yield in IP (q/ha)	Yield in FP (q/ha)	Increase in yield (%)
1	Cotton	ICM (Integrated Crop Management)	87	30	16.76	15.60	6.90
		Inter cropping	22	10	25.88	13.39	48.00
		IRM, PBW	50	20	28.67	23.54	21.79
2	Sesame (Summer)	Whole package	5	4.0	9.63	8.10	18.91
		Plant protection	2	1.6	8.40	7.90	6.33
3	Sesame (<i>Kharif</i>)	Fertilizer management	5	4.0	7.41	6.42	15.42
4	Groundnut Intercropping	Groundnut + Castor/ Pigeon pea	10	4	37.39	16.60	125.00
5	Pigeon pea	Seed treatment + Pesticides for pod borer control	10	10	18.02	14.68	23.00
6	Chickpea	Seed treatment and drenching + Pest control	20	20	23.69	19.91	19.00
7	Groundnut	50 % NPK + 10 t FYM ha ⁻¹	5	0.5	15.64	14.56	7.40
8	Wheat	100 % NPK + 10 t FYM ha ⁻¹	5	0.5	49.20	45.2	8.90

Note: 1. Improved technology includes crop production, plant protection and basic science.

2. Yield of inter cropping is the main crop (as shown in column-2) equivalent yield.

Table 4.11.3 Summary of FLDs of developed farm machineries/implements

No.	Improved Technology	No. of FLD	Total Area (ha)
1	Plastic Mulching Technology	6	1.60
2	Mobile Groundnut Thresher	4	6.70
3	Stubble shaver cum Fertilizer Applicator for sugarcane	1	1.20
4	Rotary Tiller cum Cultivator	1	1.60

Table 4.11.4 New research programs sanctioned

No.	Agency	No. of Research Programs	Amount (Rs. in Lakh)
1	ICAR	-	-
2	RKVY	1	125.00
3	Other Agencies	16	89.47
	Total	17	214.47