

**EVALUATION
OF
PRODUCTION OF JOJOBA THROUGH
RESEARCH AND EXTENSION**



(DRAFT REPORT)

**PLANNING & EVALUATION CELL
GOVERNMENT OF THE PUNJAB
AGRICULTURE DEPARTMENT, LAHORE**

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INTRODUCTION

A project for production of Jojoba was implemented/ executed by Director, Oilseed Research Institute, Faisalabad at Jojoba Research Station, Bahawalpur during 1987-92. After offer its development phase, the project was transferred to non-development side so that the research activities, may be continued. To supplement the non-development activities another project titled “**Production of Jojoba through Research and Extension**” 2006-07 to 2010-11 was initiated to enhance the capacity of the research station in term of man power and material to develop the improved production technology with main emphasis of crop. A new sub-station at Piplan was proposed with the main objective of horizontal expansion of this crop through expanding research and extension activities.

Jojoba (*Simmondsia chinensis* Link Schnider) is a perennial woody shrub or a small multistemmed tree, having height from 0.5 to 6.00 m. Normal plant range is 2-3.5 m. It starts giving production after 3-4 year of its plantation and is in full swing at the age of 9-10 years. The life of this shrub is over 100 years. The tap root of mature plants can be 15-25 m below soil surface, with substantial parallel lateral and secondary roots. Thus this plant has the ability to draw moisture from a considerable depth. This combined with sclerophyllous leaves (rather hard, stiff and remain on the plant year round) enables the plant to grow in arid regions. Plants are normally dioeciously producing male and female flower on separate plants. There is presently no practical method to determining the sex of plants prior to onset of blooms

First flowering identify the sexuality of male and female normally after 3-4 years. However, it is possible for an early detection of male and female plants by using micro propagation through tissue culture technique. The Jojoba farm design is as follows.

Per acre number of plants required:	750 plants.
Per acre ratio requirement of male & female plants	650 female + 100 male plants
Plant to plant distance	4-5 ft.
Row to row distance	12-13 ft.

The history of its introduction starts from near about 1987, when the Secretary Agriculture Dr. Zafar Altaf visited Aizona USA and comes with Jojoba seed. Bahawalpur desert area was selected for pilot project and thus Jojoba Research Station was established at Regional Agri. Research Institute Bahawalpur.

The main objectives of this Project were as follows.

- i. Direct increase in per acre yield of the farmer by incorporation of high quality jojoba seed and modern/ improved production technology.
- ii. Increase in awareness and reduction in problems of jojoba growers by interaction of farmer, researcher and extension experts.
- iii. Explore new areas/ pockets and incorporation of jojoba crop in these areas.

Scope of Jojoba in Bahawalpur

Successful jojoba cultivating countries include Israel, Mexico, Argentina, Peru Paraguay and other Latin American countries. Each country produce 200- 800 tons of jojoba oil. Australia has also started planting jojoba plantation late in its arid areas under irrigation condition in 2002 and got production of 9-12 tons in 2003.

18 – 22 inches (457 – 558 mm) water is required for successful jojoba cultivation. Israel is the most successful jojoba growing country having 30 -380 mm rainfall with supplementary irrigation of 300 mm. Native land for jojoba cultivation is the Sonoran desert (which comprises of south western Arizona, Baja California and California). It has 120–460 mm rainfall scattered in whole the year. Temperature ranges from -7 to 50 C.

TABLE-1

Area & Production of MAJOR JOJOBA PRODUCING COUNTRIES

Country	Area (Ha)	Production (tons) Jojoba seed		
		2000	2001	2002
Argentina	2700	950	1060	500
USA	2200	1455	800	1000
Israel	650	1000	1060	1100
Australia	480	07	10	40
Peru	300	30	200	335
Mexico	290	85	91	90
Egypt	140	11	25	35
Total:-	6760	3538	3226	3090

Source:

The above table indicates that there is decreasing trend in jojoba seed production from 3538 tons to 3090 tons in three years from 2000 to 2002.

TABLE-2

COMPARISON OF RAINFALL BETWEEN ARIZONA, REGION (USA) & BAHAWALPUR (FIVE YEAR AVERAGE 2005-06 TO 2009-10)

Arizona Regions weather	Total Average precipitation in inches	Total Average precipitation in mm
Apache Junction	13.4	335.0
Benson	14.9	372.0
Globe	19.8	495.0
Flagstaff	22.9	572.5
Green Valley	16.0	412.0
Litchfield	8.2	205.0
Miami	19.8	495.0
Nogales	18.7	467.0
Payson	22.3	557.5
Pinetop	28.5	712.5
Bahawalpur		153.5

TABLE-3

RAIN (MM) ANNUM OF BAHAWALPUR 2006 – 2010)

Year	Total Rain fall (mm)
2006	194
2007	275
2008	170
2009	130
2010	206
Average	

It is evident from table-2 that the rainfall of Arizona (USA) state is much higher than Bahawalpur. Thus it may be major constraints in the production of jojoba in Bahawalpur. Table 2 shows Jojoba shows that average rainfall/ annum received for the last five years 2005-06 to 2009-10 were 335, 372, 495, 572, 412, 205, 495, 467, 557 and 712 mm in different regions Apache, Benson, Globe Flagstaff, Green Valley, Litchfield, Miami Nogales, Payson and Pinetop respectively, whereas in Bahawalpur average rainfall/ annum is 153 mm. The rainfall of Bahawalpur region which ranges from 130 mm to 275 mm/ annum for the last five years as

shown in table-3 is not uniformly distributed through out the years and is much less than Arizona precipitation/ annum (ranges 205 – 712 mm).

Thus the dream of successful cultivation of jojoba in the arid lands is different to become true in Pakistan. Further more, under severe moisture stress condition, the jojoba flower remain un-open and don't dehise/ shed pollen for pollination and fertilization (Aliza Benzioni 1977- New crop Fact sheet Jojoba).

TABLE-4

**COMPARISON OF TEMPERATURE TO THE NATIVE AREAS
OF JOJOBA WITH BAHAWALPUR**

FACTORS	NATIVE AREA	PAKISTAN	BAHWALPUR
Latitude	23-29 N	24-37 N	29 N
Longitude	109-117 W	60-75 E	71 E
Temperature (C°)	(-) 5-54	5-50	1-50
RAINFALL (mm)	200-460	15-170	55-134

The above table depicts that temperature and latitude from the equator is region is almost the same as in both the cases which is favourable for growing of Jojoba crop but in different cases of longitude and rainfall.

Keeping in view the above scenario, earlier a project was approve in Eighties and through this project, efforts were made to consolidate the efforts for the discrimination of technology developed at the Jojoba Research Station established in 1984-85. The financial status of the project is given as under.

TABLE-5

FINANCIAL UTILIZATION OF FUNDS DURING THE YEAR 2006-07 TO 2010-11

Year	Allocation as per PC-I	Utilization	% age
2006-07	2.273146	1.960	86.23
2007-08	4.880850	3.833	78.53
2008-09	3.174171	2.221	69.97
2009-10	3.414521	2.777	81.32
2010-11	3.464871	Under process	-
Total:-	17.207559	10.791	73.73

Adequate funds were provided for the project as per requirement for the implementation of the project. The financial utilization is 73.73 percent. The financial utilization as per expenditure code was as follows:

ITEM WISE PLANNED AND ACTUAL EXPENDITURE

		Rs. Million	
Item		PC-I Estimates	Actual Expenditure
		Total	Total
PC-22036	A01-Employee related expenses	10.565559	5.417
	A03-Operating expenses	2.740	1.966
	A13-Repair & Maintenance	0.747	0.597
	Total PC-22036	14.052559	7.980
PC-12038	A095-Transport	1.600	1.359
	A096-Plant & Machinery	1.350	1.252
	A097-Furniture & Fixture	0.200	0.200
	Total PC-12038	3.15	2.811

The detail of item wise planned and actual expenditure is given in the table-6. The funds in the tune of 56.97 and 89.24 percents is utilized under head PC-22036 and PC-12038 respectively against the provision of PC-I. The physical progress of the project activities are as follows.

A. ITEM WISE PHYSICAL TARGETS AND ACHIEVEMENT

Item	Unit	PC-I estimates	Actual achievement	% age
Nursery raising	50000 plants	50000	35000	70
Comparison trials	12	12	09	75
Suitable plant selection for vegetative production	57	57	42	74 73.7
Demonstration plots	28	28	18	75 69.28
Fair and Exhibition	03	03	02	75 66.67
Recruitment of staff Gazette & Non-Gazette	-	5 8	5 7	100 87.5
Research paper publication	-	5	-	Nil

The nursery raising, comparison trial, suitable plant selection for vegetable production, demonstration plots, fair and exhibition and recruitment of staff Gazetted and Non-Gazetted have been achieved by 70, 75, 74, 75, 67, 100 & 87.5 percent respectively. The target for at least five publications is concerned, not a single research papers is published uptill now.

Year	Detail of physical works as phased out in the project	Detail of funds as phased out in the project	Actual physical achievement	% age physical achievement	Detail of financial progress	% age financial progress	Remarks
2006-07	One photocopier	0.194	Purchase	100	0.194	100	-
	One Computer P-IV with accessories laser printer and UPS	0.150	Purchase	100	0.150	100	-
	One tunnel	0.500	Purchase	100	0.500	100	-
	Two temperature controlling system	0.733	Purchase	100	0.0733	100	-
	Two cooling cabinet	0.06095	Purchase	100	0.06095	100	-
	One Rotavator	0.100	Purchase	100	0.100	100	-
	One Land Leveler	0.02475	Purchase	100	0.02475	100	-
	Purchase of Furniture	0.200	Purchase	100	0.200	100	-
2007-08	One single cabin with customization	1.404	Purchase	100	1.359	96.8	Due to less market value of the vehicle
	Two power sprayers	0.150	Purchase	100	0.150	100	-
	Total:-	2.857	Purchase	100	2.182	98	

The target for purchase of equipments and goods has been achieved in physical and financial terms by 100 & 98 percent respectively.

TABLE-8

YEAR WISE NURSERY RAISING TARGETS AND ACHIEVEMENTS

Year	Nursery raising targets	Achievement	% age
2006-07	5000	5000	100
2007-08	8000	8000	100
2008-09	10000	10000	100
2009-10	12000	12000	100
2010-11	15000	7000 upto 15 Oct. 2010	46.67
Total:-	50000		

Overall 70% target for raising nursery has been achieved upto 2009-10. The nursery raising target for the year 2010-11 has been achieved 46.69% upto 15th October, 2010.

TABLE-9

YEAR WISE NURSERY RAISED UNDER IMPROVED TECHNOLOGY AND IDENTIFICATION OF MALE AND FEMALE PLANTS FOR PROPAGATION

Year	Achievement (Productive Female Plants)
2006-07	-
2007-08	179
2008-09	139
2009-10	117
2010-11	-
Total:	435

Total 435 nursery productive female plants have been raised under improved technology year wise and identification of male and female plants for propagation. The progress for the year 2010-11 for nursery raising under improved technology and identification of male and female plants for propagation is under process.

TABLE-10
YEAR WISE SELECTION OF SUITABLE PLANTS FOR
VEGETATIVE PROPAGATION

Year	Target	Achievement	% age
2006-07	8	8	100
2007-08	10	10	100
2008-09	12	12	100
2009-10	12	12	100
2010-11	15	-	
Total:-	57	42	73.68

Overall 73.68 percent target for selection of suitable plant for vegetative propagation has been achieved upto 2009-10.

TABLE-11
YEAR WISE COMPARISON TRIALS CONDUCTED TO FIND OUT THE
SUCCESSIVE GROWTH OF MICRO PROPAGATED PLANTS

Year	Target	Achievement	% age
2006-07	-	-	-
2007-08	3	3	100
2008-09	3	3	100
2009-10	3	3	100
2010-11	3	-	
Total:-	12	9	75

Comparison trials to find out the successive growth of micro propagated plants through tissue culture, stem cutting and grafted plants has been achieved 75% upto 2009-10.

TABLE-12
YEAR WISE NUMBER OF DEMONSTRATION PLOTS GROWN

Year	Target	Achievement	% age
2006-07	-	-	-
2007-08	4	4	100
2008-09	6	5	83.33
2009-10	8	7	87.50
2010-11	10	2	20.00
Total:-	28	18	64.28

The overall 57.14% target for growing of demonstration plots for the awareness of farmer for jojoba cultivation has been achieved upto 2009-10. 20% target for growing of demonstration plots for the last year has been achieved 20%.

TABLE-13

YEAR WISE FAIR AND EXHIBITION CONDUCTED

Year	Target	Achievement	% Age
2006-07	-	-	-
2007-08	-	-	-
2008-09	1	1	100
2009-10	1	1	100
2010-11	1	-	-
Total:-	3	2	66.67

The overall 66.67 percent targets of fair and exhibitions had been conducted uptill 2009-10 and the last years targets of fair and exhibition will be conducted in February March, 2011.

AWARENESS AMONG THE FARMERS

Radio talks and T.V programs of 20-25 minutes duration were occasionally carried out at the research Farm Bahawalpur and Faisalabad for the awareness of farmer for the production of Jojoba. Two fair and exhibitions had been conducted for the awareness of farmers. Farmer field visits were carried out in the farmers field by research project staff.

TABLE-14

YEAR WISE LITERATURE DISTRIBUTED AMONG FARMERS

Year	Literature distributed
2006-07	550
2007-08	990
2008-09	1060
2009-10	1000
2010-11	Under process
Total	3600

In total 3600 pamphlets of production technology of Jojoba was distributed among the farmers to different jojoba plantation site and in farmers gathering.

TABLE-15

IMPACT OF PROJECT AS COMPARED TO VARIOUS PROJECT ACTIVITIES PRE AND POST PROJECT ANALYSIS

Particular	As per PC-I		Status after 2006-07
	Exhibition	New required	
Manpower			
Scientists	2	5	7
Technical support	4	2	6
Ministerial Support	3	1	4
Field Labour	9	4	13
Machinery & Equipment			
Vehicle	1	1	2
Tractor	1	-	1
Computer	-	1	1
Photo copier	-	1	1
Cooling Cabinet	-	1	1
Marketing of jojoba	No. profitable market		No change
Cost of inputs used	Farmer use low inputs		No change
Comparison of yield at Farm level & Govt. trials	Plan yields after 7-8 years of planning i.e. 1-3 kg (at Govt. trial), 0-2 kg farm level.		No change
Market price of jojoba (quality wise)	Jojoba seed rate= Rs. 70/- kg.		No change
Crop production technology.	Poor		Improved because of production of jojoba plant by stem cutting & identification of female plant at early stage.

It is evident from the table that before the project 1987-2005 manpower in shape of 2 scientists, 4-technical staffs, 3 ministerial supporting staff and 9 field labours were existing, whereas after the project manpower demanded in shape of 5 scientist, 2 technical staff, 1 ministerial supporting staff and 4 field labours were provided for the smooth implementation of project. The manpower in shape of scientist, technical staff, ministerial supporting staff and field labour were enhanced by 250, 50, 33.33 and 44.44 percent respectively. Machinery and equipment, required for the project i.e. vehicle, computer, photo copier and cooling cabinet were

provided as per requirement. Negligible adoption of Jojoba plant in the arid area resulted in meager quantity of Jojoba seed production there is no market available to sell domestic produce at profitable rates. The marketing of Jojoba is not a profitable market, because the market price of Jojoba (quality wise) seed rate is Rs.70/ kg for farmers. Market is also scarce because the quality seed available for market are very small and remains below potential demand. Jojoba plant yield at Government trial is only 1-3 kgs /plant and 0-2 kgs/ plant at farmers field. The duration for getting the plant yield is 7-8 years and additionally the cost of collecting or harvesting Jojoba seeds is high which make this Jojoba grower reluctant to grow it. It is clear in table that there is no potential buyer of Jojoba crop and no extraction unit of oil is available in the market. There is no marketing system for the purchases of oil of Jojoba exist in Pakistan. There is no change in the use of inputs level by the farmers before and after implementation of project, because there is no potential available in the crop. It is worth mentioning that there is no proper marketing system of Jojoba crop seed. It is also clear from the table that the crop production technology was poor before the project due to non-identification of female plants at early stage. There is improvement in crop production technology after the project, because production of Jojoba plants by stem cutting and identification of female plants at early stage. The objective of the project includes the collaboration of Biotechnology Research Institute, Faisalabad for micro propagation and early detection of male & female plants through tissue culture but no progress in this regard was made/ shown in the progress report.

TABLE-16

INFORMATION RELATED TO NURSERY PLANTS SUPPLIED TO FARMERS 1987-88 TO 2010-11 (BEFORE AND AFTER)

(Before Project 1987-2005)

Year	Nursery sown	Nursery Germinated	Supplied to D. plots to Growers/ Govt. farm	(Number of Plants)	
				Nursery damaged	Experimental use of jojoba farms
1994-95	20000	9000	-	1160	640
1995-96	13000	8800	-	570	7940
1996-97	7000	4200	100	380	3120
1997-98	2500	1400	700	200	500
1998-99	3000	1800	-	165	1635
Total	45500	25200	800	2415	13835

(After Project 2006-2010)

2006-07	8000	6100	2000	495	3605
2007-08	12000	8200	4500	625	3075
2008-09	15000	11000	7500	700	2800
2009-10	16000	12000	8600	678	2722
2010-11	11600	8000 upto 150 Oct.	2500	1600 due to heavy rains	1100
	62600	45300	25100	4098	13302

It is evident from the table that during the period 1987 to 2005, Total 45500 plant were grown, out of which 25200 (55.38%) were germinated. Only 800 (3.14%) plants were supplied to Government farm and farmers, 2415 (5.3%) nursery plants were damaged. Out of 25200 plants 13835 (54.90%) plants are available for experimental use at Jojoba farm Bahawalpur.

During the project period under report 2006-07, 2010-11. Total 62600 plants were grown and out of which 45300 (72.36%) plants were germinated while 25100 (55.40%) plants were supplied to the growers and Government farms for demonstration plot. 4098 (9.05%) nursery plants were damaged and 13302 (29.36%) plants are present at Jojoba farm for experimental purpose.

AREA EXPLORED FOR JOJOBA CULTIVATION BEFORE AND AFTER

Area explored for jojoba cultivation before and after project Bhakkar, District Mianwali, Layyah were explored for cultivation of Jojoba where again precipitation/ annum is 150-250 mm from south to north respectively. At Oilseed Research Station, Piplan District Mianwali the Jojoba research project was started. It is concluded that jojoba that jojoba plant can be grown at high rainfall areas successfully.

TABLE-17**AREA UNDER JOJOBA PLANTATION AT GOVERNMENT FARMS AND FARMERS FIELD****BEFORE THE PROJECT (1987 – 2005)**

#	Site	Area (Acres)	Date of Plantation	Condition of Plantation
1.	Jojoba Research Station, Bahawalpur	20 acres	1987-2009	Good
2.	Oilseeds Research Institute, Faisalabad	½ acres	1987-2009	Good
3.	M. Waris Farms Chak No. 98 ML tehsil Lal Easan, Layyah.	4 acres	2005	3 acres were cut only 1 acre left.
4.	M. Asif 85 DB Yazman	½ acres	2004	Ploughed up
5.	Tariq Mehmood, 77-IL Haroonabad	1 acre	2005	-do-
6.	Makhdoom Ahmad Anwar Alam, Mohsinabad	1 acre	2002	-do-
7.	Kafial Ali, Chak No.6 Near Head Muhammad wal Muzaffargarh.	1 acre	2004	-do-
8.	Dr. Saeed Ahmad Bukari, Multan.	1 acre	2003	-do-
9.	Tariq Hussain, Haroonabad Chak No. 71/IL	1 acre	2002	-do-
10.	Muzaffar Hussain Shah, Roomwali, Haroonabad	1 acre	2002	-do-
11.	Shahid Iqbal Yeman Mandi	1 acre	2002	-do-
12.	Ch. Akbar Ali Chak No. 195/M, Hasilpur.	1 acre	2002	-do-
13.	Muzaffar Hussain, Wattoo Chak No. 115/DRB Darem wala, Bahawalpur.	1 acre	2002	-do-
14.	M. Saleem Qadri Kumboo, Zari Farm Darenwala	1 acre	2002	-do-
15.	Khadam Hussain, Chak No.126/ NP, Ferozwala, Liaqatpur.	1 acre	2002	-do-
16.	Master M. Azam, Chak No.126/ NP, Faqirwali, Haroonabad.	1 acre	2002	Dried
17.	Ch. Muhammad Afzal, Toba Tehsil Pind Daden Khan.	6 acre	2001	5 ½ Ploughed ½ acre left.
		43		1.5 acres left

AFTER THE PROJECT (2006-07 to 2010-11)

18	Oil Seed Research Sub-station Piplan.	1 acre	2006-10	Partially damaged
19	Mian Nisaar Farm, Khanpur Boggasher, M.M. Road, Muzaffargarh.	60 acres	2006-10	Good.
20	M. Afzal Farm Pind Daden Khan, Jhelum.	60 acre	2006	5 ½ acre were cut only ½

				acre left.
21	Dr. Zafar Iqbal Farm, Leryer Srayee, Muzaffargarh.	35 acre	2006-2009	Good.
22	Rana Abdul Rehman, Chak No.268, Kahrore, Layyah.	4 acre	2006	2 ½ left.
23	Muzaffar Hussain Shah, Chak Ronwali, Haroonabad.	1 acre	2007	Ploughed up.
24	Amir Nawaz Khan Niazi, Fazalwala, Bhakkar.	1 ½ acre	2006	Good.
25	Colonel Akram Ullah Niazi, Nawan Kot Chubara.	1 acre	2007	Good.
26	Rao Abdul Rehman, Fatehpur, Layyah.	1 acre	2008	Good
27	Muhammad Rafique Ghogeer, Chak NO. 36 Rakh Dangranwala Ada Barkatwala, Draya Khan.	1 acre	2007	Good
28	Mian Ranja Burkiwala Peer Johevabad Burgadier Nawaz Towana Farm	1 acre	2008	Good
29	Zahoor Ahmad Shah Bahawalpur Road Nazir Billwala Multan	1 acre	2007	Good
30	Ch. Javaid S/O Waris ali 98 ML Fatehpur Layyah	1 acre	2008	Good
	Total:-	114.5 acre		6.5 acres ploughed up/ cut.

It is evident from the information supplied by the executing agencies that jojoba plants were grown on 43 acres at Government farms and farmers field during 1987-2005. Out of which 20.5 acres (47.67 percent) of jojoba plants were ploughed up/dried. The jojoba plants were grown at different 17 sites. Out of which only 4 sites (2 Govt. Farms 20.5 acres and 2 farmers field 1.5 acres) jojoba plantation are available in the field and 13 sites farmers field plantation had been ploughed up/dried, which reflect that million of investment made by the Government for the benefit of farmers, contributed to availability of 1.5 acre jojoba plantation from 1987-2005, which is giving no information regarding production of jojoba and benefits to the farmers.

During the current project under report jojoba plants are supplied to 13 sites (one Government farm and 12 farmer's field), which were planted on 114.5 acres. Out of which 6.5 acres (about 7 percent) were ploughed up/ cut just after three years which were grown in during period 2006-2008.

Conclusion

The conclusions of the report are given as under: -

1. Jojoba is a perennial woody shrub or small trees, multi stemmed native to the semiarid region and varying in the height from 0.5 to 6 m but usually around 2-3.5m. It starts giving produce after 3-4 years of its plantation and is in full swing when 9-10 years old. These shrubs have a lifetime over 100 years and may commonly stretch to 200 years.

2. Natural stands of Jojoba occur in an area that receives 3-18 inches of rainfall annually. Jojoba requires the most water during the late winter and early spring. Rainfall of Bahawalpur region which ranges from 130-275 mm/ annum which is much less than Arizona precipitation/ annum ranges from 205-712 mm. where jojoba is grown successfully.
3. Adequate funds were provided for the project as per requirement. As regards, physical target and achievements of the project is concerned.
4. Overall 70 percent nursery raising, target has been achieved upto 2009-10. The nursery raising target for the year 2010-11 has been achieved 46.67% upto 15th October, 2010.
5. Total 435 nursery productive female plant has been raised under improved technology and identification of male & female plants for propagation.
6. Over 73.68% target for selection of suitable plant for vegetative propagation has been achieved.
7. Overall 75% target of comparison trial to find out the success growth of micro-propagated plants through tissue culture, stamp cutting and grafted plant has been achieved.
8. Overall 57.14% target of growing of demonstration plots for the awareness of farmers for jojoba cultivation.
9. Overall 66.67% fair and exhibition had been conducted up-till now against the target.
10. Fair & exhibition were also conducted for the awareness of farmers. Total 3600 pamphlets regarding production technology of Jojoba were distributed among the farmers to different Jojoba plantation site and different gathering. As per physical targets of project 5 publications were to be published but uptill now no publication has been published.
11. During implementation of project, before and after manpower in shape of scientist was available in full strength as per provision of PC-I. Manpower in shape of scientists, technical, ministerial supporting and field labour were enhanced by 250, 50, 44.43 and 55.56 percent respectively.
12. There is no change in the inputs use level at farmers' farm as compared to before and after project.
13. There is no change in the yield of Jojoba plants at farm level and Govt. trials, which is 1 – 3 kgs at Govt. trial and 0-2 kgs at farm level before and after the project.
14. Market price of Jojoba seed (quality wise) before and after is Rs.70/ kg.
15. The crop production technology was poor before the project due to non-identification of female plant at early stage and there is improvement in the crop production technology after the project because of production of Jojoba plant by stem cutting and identification of female plants at early stage.
16. Only 800 Jojoba plants were supplied for demonstration plots to growers/ Govt. farm, 13835 (62.87%) plants are available for experimental use at Jojoba farm and 2415 (9.58%) of nursery plants were dried/ damage before the project period (1987 – 2005). Million of rupees were provided for enhancing the Jojoba crop production but up-till 2005 only 1.5 acres crop is available at farmers' field. During the project period under report 2006-2011, 25100 (55.40%) Jojoba plants were supplied to growers/ Govt. farms

for demonstration plots, 13302 (29.35%) are available for experimental use at Jojoba farm and 4098 (9.05%) nursery plants were dried/ damage. The said plants were sown at 1 acre on Govt. farms Piplan and 113.5 acres on 12 farmers field. Out of this 6.5 acres (about 6 percent) has been abounded with in 3 years.

Concluding Remarks

The Jojoba crop is by native from Arizona (USA) regions, wherein there is great decline in production of the crop. The climatic condition like rainfall, temperature etc. does not favour in ecological zone of Pakistan, therefore the efforts made by Punjab Government by Planning a project and establishing Jojoba Research Station at Bahawalpur from 1987 – 1992 and then subsequently its conservation to non development side (1987-2005), keeping in view the long period research required. In spite of investing millions of rupees on this research only 1.5 acres Jojoba crop is available at farmer's field upto 2005. Its second attempt another development project was planned and implemented from 2006-07 to 2010-11, but no fruitful outcome is seen, as the said shrubs is not profitable for growing in ecological zone of Pakistan, therefore the research station establish at Bahawalpur may be winded up and there is no justification of continuing the project under for its conversion to non-development side.

It is proposed that the surplus staff may be utilized in the other crops of oilseed for hybridization or other activities.

SUMMARY

Pakistan is heading fastly towards industrialization and the days are not far off when her economy like that of European and American countries, would be dependent on industry rather than on agriculture. Likewise, Project Planning would observe a shift over from main agricultural vision to industrial visualization. Now-a-days there is a high demand and pharmacy drugs and cosmetics on account of increased attention to life saving and development of taste for refined living respectively. These items either are imported from abroad, which is a burden on foreign exchange reserves, or are being manufactured within the country. Due to an ever increasing demand for these items the units engaged in the manufacture of pharmaceuticals and cosmetic are under rapid expansion. Similarly, other industrial units engaged in production of lubricants suffer from short supply of raw materials. Our country may not be able to bear this additional heavy load on foreign exchange reserves, which are already under heavy fire on account of import of vegetable oil to the tune of 59 billion rupees per annum. Thus keeping in view this anticipated situation, it is highly desirable that all sources of oil "Jojoba" is the one which is most talked upon. This crop has the potential to alone feed all the industries like pharmaceuticals, cosmetic, lubricants, paints etc. Since its oil (wax) is unique in fitness for all of these.

2. There is presently no practical method to determine the sex of plants/ fruits prior to on set of blooms while strengthening the presently working Jojoba Research Station at Bahawalpur and establishing a new Research Sub-Station at Piplan, in a project "**Production of Jojoba through Research and Extension**" efforts would also be made to find out ways and means with the collaboration of Agri-Biotechnology Research Institute, Faisalabad for micro propagation and an early detection of male and female plant through tissue culture in order to overcome the aforesaid problem. In addition to that comparison will be made to find out the successive growth of micro propagated plants through tissue culture, stem cutting and grafted plants.

3. As depicted in its title, promotion tasks of Jojoba would be accomplished through the collaboration of the extension wing of Agriculture Department and dissemination of production technology through print and electronic media. This basis of selecting aforementioned areas (Bahawalpur and Piplan) for this project is that the Agro-climatic environment of that region is quite favourable for jojoba plantations. Research work on jojoba at Bahawalpur would be conducted under the supervision of Jojoba Botanist, Bahawalpur whereas, research work at Oilseed Research Farm, Piplan would be supervised by the Director, Oilseed Research Institute, Faisalabad.

4. The finding as per results reached after the analysis of information provided by the Director, Oilseed Research Institute, Faisalabad. It is observed that Jojoba is a woody shrub or small tree, multi-stemmed, varying in height from 0.5 to 6 m but usually around 2 – 3.5 m. It starts giving produce after 3 – 4 years of its plantation and is in full swing when 9-10 years old. Natural stands of Jojoba occur in an area that receives 3-18 inches of rainfall annually. Jojoba requires the most water during the late winter and early spring. Rainfall of Bahawalpur region which ranges from 130 – 275 mm/ annum which is very less than Arizona precipitation/ annum ranges from 205 – 712 mm/ annum. Adequate funds were provided for the project as per requirement for implementation and achievement of physical targets of the project before and after. But no fruitful outcome is seen. Millions of rupees were provided for enhancing the jojoba crop production for the project 1987 to 2005 and only 1.5 acres Jojoba plantation is available at farmers field. Its second attempt another development project was planned and implemented from 2006 to 2010-11, the jojoba plants are grown on 113.5 acres of farmers fields. Out of this 6.5 acres has been abounded with in 3 years.

5. As per results of the report, the project seems to be non-profitable for growing of jojoba crop in ecological zones of Pakistan due to its long duration plantation and its in full swing when 9-10 years old. It is proposed that the Jojoba Research Station established at Bahawalpur may be winded up and there is no justification of continuing the project under for its conversion to non-development side.

6. It is further proposed that the surplus staff may be utilized in other crops of oilseed for hybridization or other activities.