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Organic linseed (Tisi) farming:

a step towards doubling farmers' income

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Rainfed organic cultivation of Linseed crop variety T397 in farmer's field (Ranchi district, Jharkhand)

Raw organic produce (Linseed) and SGS- National Programme for Organic Production (NPOP) in FabIndia, Patliputra

AMONG the oilseed crops raised during *rabi*, linseed is next in importance to rapeseed-mustard in area as well as in production. In technical oil production, it ranks first in the country.

Organic products in India is still a small niche market hence; at present there is not a sufficient number of producers to meet the growing demand in the cities. Coupled with inadequate transport infrastructure, lack of storage facilities and high losses, this brings up the cost of organic produce. At the same time, many organic farmers do not have access to organic markets and are forced to sell their produce in conventional outlets, losing out on the premium.

With recent development of super markets in several cities of India and few showrooms of Organic India, Ecofarms, FabIndia and Navdanya etc. the marketing of processed organic produce got accelerated. However, it is not sufficient for large chunk of raw organic produce of India.

FabIndia's three categories of food products

Green logo: Products displaying our green logo are 'Fully Certified' Organic All process, from growing to preparing to packing have been done according to National and International Standards, verified by accredited agencies.

Blue logo: Products displaying our Blue logo are ' in conversion'. This means that the farmer is using purely organic techniques, and has registered and is complying with set standards, farmland must be managed organically for about 3 years before it can be fully certified.

Yellow logo: Products displaying our Blue logo are ' Natural'. This category contain products produced by small farmers who use purely organic technique, but who have decided to not yet register for certification also includes some processed food, which do not contain synthetic preservatives, colours, flavours or additives.

Every part of the linseed plant is utilized commercially, either directly or after processing. Seed contains 33 to 47% of oil. On a very small scale, the seed is directly used for edible purposes. About 20% of the total oil produced is used at farmers' level, and the rest 80% oil goes to industries in various forms, such as boiled oil, borated oil, eposidized oil, aluminated oil, urethane oil, isomerized oil etc. The oil is rich (> 66%) in linolenic acid, and is a perfect drying oil. Hence it is utilized in the manufacture of paints, oil cloth, varnish, pad-ink, printed ink, linoleum etc.

The oil-cake is a good feed for milch cattle and poultries and hence priced 50% higher than rapeseed-mustard cake. It is good in taste and contains 36% protein, 85% of which is digestible. It is also used as organic manure. It contains about 5% N, 1.4% P_2O_5 and 1.8% K_2O.

Linseed is globally cultivated for its fibres and is called flax. Fibres are used for the manufacture of linen. The stem yields fibre of good quality having high strength and durability. The weather resistant fibre is lustrous and blends well with wool, silk, cotton etc. Strong twines, canvas,

suitings, shirtings and various indispensable products for defence purposes are manufactured from it. Woody matter and short fibres may be used as raw pulp for making paper of quality comparable with that of currency notes. The rough and strong linseed fibre can effectively be used for low-cost roofing tiles based on convertible polymers and for fibre-reinforced plastic (FRP).

Climatic requirements

Linseed is a cool season crop. The temperature during the vegetative development of the crop should be moderate or cool. Temperature above 32°C accompanied with drought during the flowering stage reduces the seed yield, oil content in seed and also the quality of the oil. Moderate temperatures (21°-26°C) are ideal. At the flowering, frost is very harmful to the crop.

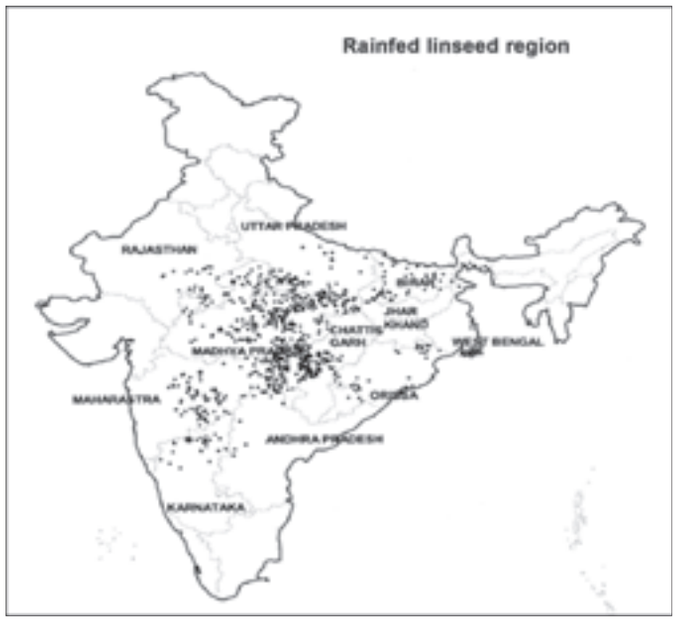
The crop is well suited to tracts of low rainfall and is generally raised where the average annual rainfall ranges from 45 to 75 cm.

Soils and its preparation

Linseed can be profitably raised in places where the other crops may fail. Hence, it is often grown on marginal and sub-marginal rainfed soils as pure crop, mixed crop, intercrop and *paira* or *utera* crop.

National scenario

Bihar, Chhattisgarh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Nagaland, Odisha, Uttar Pradesh and West Bengal are the major linseed growing states. Area under linseed cultivation has declined from 4.68 lakh ha (2007-08) to 3.03 lakh ha during 2013-14. However, the productivity of linseed has increased from 413 kg/ha to 462 kg/ha during the same period. The state wise area, production and productivity of linseed during 2011-14 (3 years) is given in Table 1.



District-wise promising technologies for rainfed linseed based production system in India (2005).

Linseed can be raised in almost all types of soils, where sufficient moisture is available, but it also does better on heavier soils having greater water-retention capacity. It is also tolerant to wide range of soil pH (5.0-7.0). However, it grows best on well drained loam to clay loam soils rich in humus. In Madhya Pradesh and Maharashtra, linseed is largely raised on black cotton soils having high clay and lime content. It is also raised on light alluvial soils of Uttar Pradesh, Bihar, Jharkhand and West Bengal.

Land should be ploughed 2-3 times followed by 2-3 harrowings to bring a fine tilth. To conserve moisture, it is advisable to create a soil mulch with the help of a hoe after each good shower. *Utera* cropped linseed needs no land preparation, as it is broadcast in standing rice crop.

Seed and sowing

Linseed seeds are scientifically sown as discussed here.

Seed rate, seed treatment, time of sowing and spacing: A seed rate of 25-30 kg/ha is usually followed and sown by broadcast or by drilling in rows at row spacing of 25 to 30 cm. The seed requirement is more in bold-seeded varieties and in *utera* cropping system. Treat the seeds with Trichoderma @ 4 g/kg seed before sowing. This ensures a good stand by protecting seedlings against seed-borne diseases. An inter-row spacing of 20-30 cm and intra-row spacing of 7-10 cm are ideal. The time of sowing varies from early October to mid-November in different states. Rainfed crop requires early sowing. Early sowing also helps the crop to escape from powdery mildew, rust and pod fly menaces.

Table 1. Statewise area, production and yield of linseed during 2011-2014

States	Area (lakh ha)			Production (lakh tonnes)			Yield (kg/ha)		
	2011-12	2012-13	2013-14	2011-12	2012-13	2013-14	2011-12	2012-13	2013-14
Asom	0.07	0.07	0.07	0.04	0.04	0.04	571	571	571
Bihar	0.23	0.24	0.2	0.2	0.21	0.17	870	875	850
Chhattisgarh	0.39	0.31	0.26	0.14	0.09	0.11	359	290	423
Jharkhand	0.24	0.25	0.26	0.13	0.16	0.15	542	640	577
Karnataka	0.09	0.07	0.06	0.02	0.02	0.02	222	286	333
Madhya Pradesh	1.2	1.1	1.02	0.57	0.53	0.53	475	518	520
Maharashtra	0.31	0.26	0.31	0.08	0.08	0.08	258	346	258
Odisha	0.25	0.25	0.23	0.12	0.11	0.11	480	480	478
Uttar Pradesh	0.31	0.3	0.26	0.14	0.12	0.12	452	452	462
West Bengal	0.04	0.04	0.1	0.02	0.02	0.02	500	500	200
All India	**3.23**	**2.97**	**2.87**	**1.53**	**1.5**	**1.43**	**474**	**505**	**498**

Depth of seeding: Depending upon the soil moisture, the seed should be placed 2-3 cm below the soil. However, shallow sowing is always advantageous, if there is adequate moisture in the soil.

Varieties: The linseed varieties recommended for different states are given Table 2.

Nutrient management

Linseed crop is generally grown without manuring. However, under rainfed situations best crop is raised with use of organic source i.e., application of 2.5 tonnes of vermi-compost /ha at the final field preparation. But in irrigated situations, total amount of vermi-compost is divided in two equal parts i.e., @ 1.25 tonne as basal and the remaining 1.25 tonne is applied with the first irrigation 35 days after sowing.

Water management

Linseed is a crop of rainfed areas (> 90%). However, it responds well to irrigation. Branching, flowering and capsule formation stages are critical for irrigation. Two irrigations are sufficient to obtain good yields. First irrigation should be applied 30 to 40 days after sowing and the second just before flowering. However, 3 irrigations (35, 55 and 75 days after sowing) have proved effective.

Weed control

This crop is usually dwarf statured, and therefore suffers severe competition by weeds. Initial 3-6 weeks after sowing is critical period of crop-weed competition. The uncontrolled weeds can reduce yields by 25 to 40%. The losses are more in rainfed and *utera* cropping systems primarily due to competition for moisture followed by nutrients.

The important weeds of linseed include *Anagallis arvensis, Vicia hirsuta, Fumaria parviflora, Melilotus* spp., *Chenopodium album*, *Phalaris minor* etc. The crop is parasitized by *Cuscuta* sp. leading to heavy losses of yield.

In line sown linseed crop, power weeder (covering 22 cm width of land between rows) when used twice (3 and 6 weeks of sowing) has been found most eco-friendly, efficient and economical.

Cropping systems

Linseed is a component of various sequential and intercropping systems. Higher monetary returns can be realized, if linseed is grown as a pure crop instead of a mixed or intercrop. It is usually grown in rotation with rice, hybrid maize, sorghum, pearl millet, soybean, groundnut, cowpea etc.

Piara or utera cropping: This system has been in practice for efficient use of residual moisture in rice fields, where tillage is a problem. About 25% of the linseed area (0.5 million ha) is under *utera* cropping. The area under linseed is increasing with the decline in *khesari* (*Lathyurus*) cultivation. In this practice, linseed is broadcast in the standing rice fields, when the rice crop is between flowering and dough stages. Linseed is allowed to complete its life-cycle under moisture stress, with inadequate nutrients and plant-protection measures, resulting in poor yields. To raise the yield levels, the package of practices should be adopted (Table 3).

The intercropping systems suitable for different states are listed below.

Cropping system	Row ratio	States
Linseed + chickpea	2-3:1	West Bengal, Bihar, Jharkhand, Bundelkhand region of Uttar Pradesh, Madhya Pradesh, Punjab, Maharashtra, Karnataka
Linseed + wheat	2-3:1	West Bengal, Maharashtra, Karnataka, Uttar Pradesh
Linseed + sunflower Linseed + potato	3:1	Karnataka Bundelkhand region of Uttar Pradesh

Improved varieties should be raised for the purpose of more productivity and good quality oil. Heavy textured soils with good water-retention capacity are ideal for this system. Manual weeding should be given once or twice.Crack system of sowing is a new method, which can be followed in areas where sufficient water is available. In this method 5 cm deep cracks are allowed to develop in the field, when the rice crop is at the boot-leaf or panicle formation stage and the field is

Table 2. Linseed varieties recommended for different states in India

States	Varieties
Madhya Pradesh	Jawahar-1, Jawahar-17, Jawahar-18, Jawahar-552, Jawahar-7, Jawahar linseed-9, Jawahar-23, T-397, Sheetal, Pusa-2, Padmini (LMH-62), Kiran (RLC-6), Parvati (LMH-16-5)
Uttar Pradesh	BAU-204-1, Garima (LHCK-39), Gaurav, Hira, Jawahar-23, Jeevan (DLP-21), T-397, Swetha (LHCK-131), Subhara (LHCK-21), Shekhar (LCK-9313), Mukta, Sheetal, RL-993, Padmini, Neelum, Meera (RL-933), Shikha (LCK-8528), Laxmi-27, Rashmi (LCK-9216), Parvati
Bihar and Jharkhand	BAU-204-1, Gaurav, Jeevan, T-397, Swetha, Subhara, Sekhar, RL-993, Shikha, Rashmi, RL-914
Odisha	Jawahar-23, Sheetal, Pusa-2, Padmini, Kiran
West Bengal	BAU-204-1, Gaurav, Jeevan, Swetha, Subhara, Sekhar, Neela, RL-993, Meera, Shikha, Rashmi
Asom	Gaurav, Jeevan, T-397, Swetha, Subhara, Sekhar, RL-993, Meera, Shikha, Rashmi
Maharashtra	C-429, Jawahar-23, S-36, Jagadamba (RLC-4), NL-97, Sheetal, Pusa-2, Kiran
Rajasthan	Jawahar-23, Triveni, T-397, Surabhi, Sheetal, RL-993, Pusas-3, Pusa-2, Padmini, Meera, Kiran, LC-54, Rashmi
Punjab	Jeevan, Surabhi (KL-1), Pusa-3, LC-185, LC-54, Sheela (LCK-9211), K2
Haryana	Jeevan, Surabhi, Pusa-3, Pusa-2, LC-54, Sheela, K2
Himachal Pradesh	Janaki, Himalini, Jeevan, Surabhi, Pusa-3, Pusa-2, LC-185, LC-54, Sheela, K2
Karnataka	Jawahar-23, Sheetal, Pusa-2, Kiran

Table 3. Economics of organically grown linseed per hectare

Particulars	Quantity	Rate (₹/unit)	Amount (₹)
Land preparation (Cris-cross ploughing)	Twice	2,500	5000
Seed	30 kg	70	2100
Vermi-compost	2.5 t	6,000	15000
Sowing by seed drill	-	8,000	8000
Trichoderma fungicide	150 g	200/100 g	300
Irrigation	3	2,000	6000
Weeding by power weeder	2 times	2,000	4000
Labour for sowing, weeding, harvesting and threshing	25	250	6250
Total cost of production			46650
Linseed grain yield	490 kg	500	245000
Benefit : Cost ratio			5.25

irrigated. After keeping the water standing for 5-7 days, the normal practice of *utera* is followed. This method has been found to give 50-100% more yields and has no adverse effect on rice yields.

Harvesting and threshing

The crop takes about 130 to 150 days to mature. At maturity, the leaves become dry, capsule turns brown and the seed becomes shiny. After harvesting, bundle the plants and leave them on threshing floor for 4 to 5 days for drying. Threshing is done by beating the plant with sticks or trampling by bullocks.

Yields

The crop yield varies from place to place depending on the climate, soil, technology and variety. A well managed crop may yield 1.5 to 2.0 tonne of seeds/ha.In linseed oil to seeds crushed is 33% while cake to seeds crushed is 67%.

SUMMARY

Linseed is nutritionally rich and have many health benefits for organic production. It can be grown in marginal lands under different agro-climatic conditions of India with assured harvest. It is short duration, drought resistant, easy for cultivation with limited external inputs, fewer pests and diseases and long storability of grains without store pests damage are unique qualities and hence can be a step forward for doubling the income of farmers in india.

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Double pig farmers income through artificial insemination in Nagaland

To fulfill the deficiency and disseminating the improved germplasm of pig, ICAR Research Complex for North-Eastern Hills Region, Nagaland Centre initiated the production of quality germplasm of Gunghroo and Hampshire cross under Mega Seed Project on Pig in collaboration with NRC on Pig, Rani, Guwahati in 2009-2010 funded by ICAR, New Delhi with the objectives of introducing quality pig germplasm with superior genetic merit and production potential, facilitating two extra per farrowing, production of 1,000 quality piglets for covering about 200 farm families/ annum and capacity building in the centre to produce above number of quality piglets. Since inception of the project, total 4,473 numbers of improved piglets were supplied to 1,048 beneficiaries from Nagaland, Asom, Meghalaya, Arunachal Pradesh and Manipur.

In 2013-14, artificial insemination was standardized and introduce for the first time in Nagaland under the same project. ICAR North-Eastern Hills Region, Nagaland is the only centre providing Artificial Insemination (AI) technology to Nagaland and adjoining areas of Asom. In the farmers' field, one natural mating cost a farmer ₹ 1,500 to 2,000/ - or one piglet in exchange in addition to the transportation cost of the female pig. ICAR Nagaland Centre is providing two Artificial Insemination kits @ ₹ 150/- per pig. The major factor which makes the farmer to adopt Artificial Insemination is cheap, ready availability and easy to do *i.e.* a farmer can do themselves. In our efforts to disseminate Artificial Insemination in Nagaland to improve upon pig production status, 29 on farm training was conducted for farmers, veterinary officers, NGOs, SHGs, KVKs, VFAs etc. As a result, several farmers became AI entrepreneur and doing it in farmer's field regularly.

Vitsongonou Nakhro, aged 45, a lady farmer and part-time business woman from Jotsoma village, Science College colony, Kohima was rearing pigs in the traditional way. She attended a three days training at ICAR Jharnapani on artificial insemination in pig and thereby she learned the scientific management of piggery including rearing of improved breeds, feeding, proper heat detection, castration, artificial insemination and pig manure utilization. After the training she started doing artificial insemination with liquid boar semen from ICARNEH, Nagaland Centre, Medziphema in her own sows and thereafter for other farmers. Artificial insemination is now more popular than natural service in Jotsoma and neighbouring villages. ICARNEH, Nagaland Centre has provided her with a breeding unit of five Gunghroo and Hampshire cross piglets. She has sold 120 improved breed piglets of her own sows born by artificial insemination and also expanded her breeding farm. Within the three years following the training, she has carried out 282 artificial inseminations in Jotsoma and neighbouring village with farrowing rate of 86.35 % and average litter size of 9.83 being farrowed. By doing single successful , artificial insemination, she is earning ₹ 1,000 to 1,500/- and farmers are ready to pay this amount in expectation of getting good quality piglets in large litter size. With a total farrowing of 2,400 piglets, Vitsongonou Nakhro has succesfully established the advantages of doing, artificial insemination in Jotsoma village and also proven that women can lead from the front even in unexplored spaces such as piggery development in Nagaland which is still a long way behind other states. This is an encouragement to both the scientific community as well as the farmers in general and another example in empowerment of women.