ISSN: 2457-0761

JBC-APRF-3(4): 53-53, 2019

JOURNAL OF BIODIVERSITY AND CONSERVATION

Oil yielding wild plants and their utilization: a review

Harekrishna Nial[1], Sweta Mishra[2] and Gyanranjan Mahalik[1 *]

[1]Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India

[2]Ambika Prasad Research Foundation, Odisha, India

Email-Id: gyanranjan.mahalik@cutm.ac.in

ARTICLE INFO

Article History

Received: 14 September 2019

Received in revised form: 24 October 2019

Accepted: 25 November 2019

Keywords: Biofuels, Cultivation, Nabarangpur, Oils seed, Pharmaceutical

ABSTRACT

Seed is the fundamental and essential contribution for effective yield generation, which holds the way to the ranch efficiency and benefit. Oils obtained are either used for edible purposes or are found to be used as medicinal uses and cooking purposes. Recently oil yielding plants attract more attention due to an increasing demand for their vegetable oils, livestock feeds, pharmaceutical biofuels and other chemical industries. The oil seed cultivation practices along with the climatic conditions prevailed in these particular area has its impact on yield of oil seeds. Good cultivation practices are needed to preserve and for getting maximum yield which can be used as alternatives for their livelihood.

INTRODUCTION

Fat and oils are the primary wellspring of vitality, that we can use as sustenance, medivines, beautifiers and fuels, legitimately or as fixings in the arrangement of completed items (O'Brien 1998; Odoemelam 2005). Fats give 9 kcal/gm of power, while protein and starches as 4 kcal/gm separately (Rabasco Álvarez & González 2000). The Food and Agriculture Organization and the World Health Organization have recorded the significance of oils as a wellspring of liveliness for cell capacities, wellspring of fundamental unsaturated fats, helping in transportation of oil dissolvable nutrients and control of blood lipids and can be utilized as phenomenal excipients in pharmaceuticals, cosmetical items (Athar & Nasir 2005). In treatment of rheumatoid joint pain, primrose oil containing higher level of y-linolenic

corrosive used (Dagne & Jonsson 1997). Oil containing high polyunsaturated unsaturated fats is valuable to lower blood cholesterol, which limits the danger of cardiovascular issue; this demonstrates oils have therapeutic properties (Aubourg et al. 1993; Čmolík & Pokorný 2000). In spite of the fact that plant oils have nourishing and restorative qualities, it isn't yet evident whether they can be used without refining, since danger has been related in the rough oils. The most well-known business consumable seed oils, for example, canola, soyabean, sunflower and cotton seed oils likewise can't be utilized for palatable purposes before refining (Dawodu 2009). Plant seed oils is additionally significant wellspring of cell reinforcements as phenols, have numerous medical advantages. Seed oils are of the two sorts eatable and non-consumable relying upon their physio-concoction properties. High unsaturated oil acts like drying operator, so they are utilized in arrangement of varnishes, paints, wood treatment items (Giuffre et al. 1996). Oils having high breaking point, streak point so they can be utilized in oil shower and as separators in the electrical business (Oommen & Claiborne 1999). Oils are biodegradable and non-harmful or nonallergical for skins. Many plant oils have comparable physico-compound properties to those of diesel fuel and may substitute for this fuel (Schwab et al. 1987). Plant oils effectively utilized as powers, for example, canola, sunflower, soybean and palm oils (Athar & Nasir 2005). Oils can be utilized in unadulterated structure or in mixed with standard diesel and different biofuels (Pioch & Vaitilingom 2005). In India oils are expended at exceptionally high scale in various applications, so there is have to concentrate on un-used wild seeds for conceivable improvement and commercialization and to defeat from deficiency issue, for meet our prerequisites of oils according to request. Many plant species give seeds which are being used in various ways. Seeds of *Euphorbia angustifolia, Paspalum longiflorus, Pinus roxburghii, Coriaria nepalensis, Schleichera oleosa*, are eaten crude or cooked. Seeds of *Dendrocalamus polypoldes* look like that of wheat and are palatable. Flour from the seeds of *Atriplex hortensis*, is viewed as wealthy in Vitamin A and regularly eaiten in eye inconveniences. Seeds of *Bauhinia vahlii*, are seared in margarine oil and eaten, *Shorea robusta* seed and the kernel from the product of *Mangifera indica* are likewise utilized during shortage (Gupta 1989). The backwoods of Garhwal area are wealthy in oilseed bearing species. Oils from these seeds can supplant the eatable oils utilized in different ventures and henceforth can spare outside trade (Singh & Gupta 1979). The vegetation of Dehra Dun can be ordered under Northern Tropical moist Deciduous Forest, Hydrophytic vegetation is found in monsoonal lakes, trench, puddles, lakes, overwhelms recently made by dammed up water in waterway beds and gorges, and flooded rice fields. The species for the most part found are *Vicia sativa, V. tetrasperma, V. hersuta, Potentilla prostrate, Ranunculus arvensis, Cotula hemispherica, Soliva anthemifolia, Panicum walense, Galium elegans* and so forth. (Hall et al. 2006).

Different oil seeds

This section will provide a brief introduction and background for the oilseeds uses.

Flax seed

Flax, *Linum usitatissimum* L., is an oil seed crop in the family Linaceae. Proof of utilization by people goes back to around 8,000 B.C. in the Fertile Crescent (Hall et al. 2006). Flax is named a "Close East

author crop" alongside emmer wheat, einkorn wheat, grain, lentil, and pea. Flax seeds have been found by developed wheat seeds in Turkey, Iran, Israel and Jordan, with an expected date of 8,000 B.C. (Zohary & Hopf 2000), recommending that wild flax was used, albeit maybe not tamed, alongside wheat. Vasey-Genser and Morris (2003) place the start of flax development at around 7,000 B.C., while Hall et al. (2006) give a wide gauge of between 7,000 B.C. furthermore, 4,500 B.C. Flax stem filaments, the entire seed, and the oil removed from the seed have been utilized for centuries. Flax strands have been utilized to make fabric and paper (Flax Council of Canada, 2002; Ehrensing, 2008). The entire seed has been expended as an oat grain, and oil removed from the seed has been utilized as cooking oil, as light oil, and as a medium in paint and varnish (Vaisey-Genser & Morris 2003). The medicinal properties of flax were perceived in antiquated occasions (Pengilly 2003) and flaxseed is currently making a rebound as a wellbeing nourishment in light of its lignans, high fiber content (about 28% on a dry-weight premise), and high rate (23% on a dry-weight premise) of alpha-linolenic acid, one of the omega-3 unsaturated fats (Vaisey-Genser & Morris 2003). A few conceivable medical advantages are guaranteed for flax, including security against a few sorts of malignancy, decrease in blood cholesterol and blood glucose, and insurance against coronary illness and stroke (Anjum & Hussain 2007). The topographical source of flax is either the Near East or the Indian subcontinent (Vaisey-Genser & Morris 2003). Natural assorted variety of the sort *Linum* is most prominent in India, and flax effectively could have been conveyed from India to the Middle East along an exchange course .In present day times flax development has spread to every one of the five landmasses. In spite of the fact that flax fiber is significant in certain nations, oil generation is the transcendent purpose behind flax development today. Information from 2002 demonstrates that the world chief in flax generation is Canada, with about 33% of the overall aggregate of 2 million metric huge amounts of flaxseed. China is an inaccessible second maker with 20%, trailed by the United States, and India (Hall 2006).

Camelina

Camelina sativa (L.) Crantz., otherwise called gold-of-delight, false flax, large seed false flax, linseed dodder, leindotter, and Siberian oilseed, is an individual from Brassicaceae family. In North America, it was for the most part known as a weed (Lafferty et al. 2009). There are clashing perspectives about the starting point of Camelina. As indicated by Hunter and Roth (2010), Camelina is local to a territory from Finland to Romania and east to the Ural Mountains; in any case, Putnam et al. (1993) accept that the plant is local to Central Asia and the Mediterranean. Camelina was developed in Neolithic occasions. During the Bronze Age (3200 to 600 B.C.), camelina was developed in Europe just because. Camelina seeds were squashed and bubbled for nourishment, therapeutic and light oil purposes or camelina seeds were eaten before the yield was prepared (Hunter & Roth 2010). In the Iron Age (1200 B.C. to 400 A.D.), when the quantity of harvest plants around multiplied in Europe, Camelina was basically utilized as a plant for providing oil (Putnam et al. 1993). Proof additionally exists that Camelina was planted in the Rhine River valley as right on time as 600 B.C. After the Industrial Revolution, camelina oil was utilized as modern oil. Camelina seeds were bolstered to confined fowls while the straw

was utilized as fiber (McVay & Lamb 2008). As of late, due to an expanded enthusiasm for vegetable oil wealthy in omega-3 unsaturated fats, Camelina creation has expanded. Camelina has potential as an ease feedstock for biodiesel generation. The superb supper can be utilized in creature feed to deliver high omega-3 eggs, grill chickens, and dairy items. Camelina creation can possibly be extended later on to fulfill these needs (Hunter & Roth 2010). Due to its high water-use proficiency and dry spell resilience, more noteworthy spring-solidify resilience, insect scarab opposition, better adjustment to minor developing conditions, short creation cycle, and capacity to fit in a wheat-based yield revolution framework, especially in semiarid high plain territories, endeavors are in progress to deliver Camelina as a low-input crop in dryland regions. Montana, and other Northwestern states, just as Alberta, Canada are places where camelina creation is occurring on enormous scale dryland real esatate (Lafferty et al. 2009).

Sunflower

Sunflower (*Helianthus annuus*) is a yearly plant local to the Americas. It has an enormous blooming head. The heads comprise of numerous individual blooms, which develop into seeds. Sunflower seeds and sunflower oil are far reaching cooking fixings. Sunflower (oilseed type) seeds contain 38-half oil and around 20% percent protein. Leaves of the sunflower plant can be utilized as steers feed alongside the leftover supper from oil creation. The stems have mechanical uses, for example, paper creation. Sunflowers can effectively utilize water, which may turn out to be significant in Colorado and different territories of the Western U.S. as water assets become increasingly restricted. Specialists with the USDA found that under restricted and coordinated water system, sunflower has a one of a kind capacity to create a higher yield than under boundless (Boland & Stroade 2004). Sunflower oil is an exceptionally rich wellspring of different unsaturated fats, predominantly linoleic acid. Safflower oil is viewed as the most extravagant wellspring of linoleic acid and iodine among oilseed crops. Furthermore, it is known as a rich wellspring of proteins, amino acids, minerals and nutrients. The feast is wealthy in fiber and protein, with an expected protein substance of around 25 percent. It is mostly utilized as a protein supplement for domesticated animals and poultry feed (Berglund et al. 2007).

Cuphea

The genus *Cuphea* spp. has a place with the family Lythraceae, which comprises of around 250 herbaceous or enduring wild species (Graham et al. 1981). The vast majority of the species are local to Mexico and Central and South America; be that as it may, one species, *C. viscosissima*, is accepted to be local to the United States (Knapp 1990). A large portion of the *Cuphea* species can create and store medium-chain unsaturated fats (MCFA) in their seeds. A portion of the MCFAs, for example, capric, lauric and myristic acids, are significant feedstocks in assembling wide range synthetic items (Knapp 1990; Gesch et al. 2002). Lauric and capric acids have a wide scope of mechanical, therapeutic and nourishing uses. *Cuphea* oil is utilized in biting gum, as a dissolvable in the sweet business, as a defoaming operator, as a sponsor in cleanser and cleanser, and in beauty care products, particularly lipsticks, salves, creams, shower oils and sun screen. Cuphea oil is appropriate for biofuel creation, especially biodiesel and fly powers (Knapp 1990). Since the greater part of the Cuphea species are exceedingly alluring to nectar bolstering creepy crawlies and

humming birds, cuphea has another use at the retail level (Schoellhorn 2004).

Canola

Oilseed assault, *Brassica napus*, is viewed as the world's second biggest oilseed crop, in charge of 13 percent of the world's supply of oilseed. Rapeseed was among the antiquated yields that were trained by early man. Early records have indicated development of rapeseed in India 3,000 years back Rapeseed purportedly was brought into Japan and China around the season of Christ (Raymer 2002). It has been developed in Europe since the thirteenth century (Oplinger et al. 1989). In North America, rapeseed was brought into Canada during the 1930s, yet business creation was not begun until 1942. During World War II, when there was a huge interest for modern ointments, rapeseed generation began in western Canada to fulfill this need (Raymer 2002). A modest quantity of rapeseed likewise was apportioned for cooking oil generation on account of a palatable oil deficiency during World War II. Be that as it may, genuine endeavors toward reproducing rapeseed as a wellspring of consumable oil were proposed in 1948 in Canada. During 1956 to 1957, the principal business extraction of rapeseed for palatable oil occurred in Canada (Sediqi 2012). In 1957, the main rapeseed assortment with low-erucic acid substance was grown however not discharged. The name canola alludes to assault seeds with hereditarily lower erucic acid and glucosinolates. The name canola was trademarked by the Western Canadian Oilseed Crushers Association in 1978 (Oplinger et al. 1989). Albeit a few Brassica animal varieties can possibly deliver canola assortments, Brassica napus is viewed as the most widely recognized one in the United States. Canola is as of now created from three diverse *Brassica* species; *Brassica napus*, *Brassica rapa*, *and Brassica juncea* (Sediqi 2012).

Mahua

Mahua, the Indian Butter Tree (*Madhuca longifolia*) is a significant tree having imperative financial worth and developing all through the tropical and subtropical district of the Indian subcontinent. It is a deciduous tree that develops generally under dry tropical and subtropical climatic conditions. It is exceptionally tough and flourishes well on rough, gravely, saline and sodic soils, even in pockets of soil between hole of fruitless shake (Singh 1998). Mahua (*Madhuca indica* J.F. Gmel. syn. *Madhuca latifolia* Macb.) having a place with the family Sapotaceae (Banerji & Mitra 1996). It is one of those multipurpose timberland tree species that give a response to the three noteworthy i.e. food, fodder and fuel (Patel et al. 2011). Natural products are eaten as crude or cooked. The natural product mash might be used as wellspring of sugar, though the dry husk makes a decent wellspring of alcoholic maturation. Seeds are great wellspring of oil. The tree, known under the name of Mahua, produces palatable blooms and natural products. The leaves of Mahua tree contain saponin, an alkaloid glucoside. Sapogenin and other fundamental corrosive have been found in the seeds. Mahua blossoms are outstanding for their high diminishing sugar and supplement content. Blooms of the plant are palatable. The corolla generally called as Mahua flowers is a rich wellspring of sugar containing calculable measure of nutrients and minerals (Singh et al. 2005).

Oil seed situation in India

India is a nation mostly reliant on its farming. Food grain creation was 144 million tons in 1986-87 contrasted with 151 million tons in 1985-86. A drop of 14 million tons from the year 1985-86 has been

appeared in Kharif nourishment grains which are because of far reaching dry season influencing the whole country. This talks about the reliability of our farming on nature. Oilseeds coming by sustenance grains, assume a significant job in the farming and mechanical economy of our country. Oilseeds, oils and their subsidiaries comprise 11% of the average cost for basic items record and oilseeds possess about 15% of the absolute trimmed zone. Creation of real oilseeds expanded by 5-7% to 11.45 million tons in 1986-87 against 10.83 million tons in the earlier year. In the course of recent decades, the generation of oilseeds has expanded however the expanded creation has been because of increment in real estate under development instead of expanded profitability per hectare. Our profitability per hectare is much lower than somewhere else (Chakrabarty 1980). The low yield/hectare in our nation is because of minor or underneath minimal grounds utilized for generation, absence of water system, carelessness to creepy crawly, nuisance and ailment control, and composts, and utilization of seeds which are of substandard quality. Oils and oilseeds are significant wares on the planet exchange. India is a noteworthy maker of oilseeds in the world,but it has been shy of oilseeds, oils and fats throughout the previous quite a while. In this way, India, ovar the previous decade, has changed from being a major exporter to a huge shipper. Oils and fats are basic things of utilization in all pieces of the world. Diet overview of the National Nutritian Monitoring Bureau demonstrates that the fat admission in India extends between 5-25g/day relying upon the area and pay (N. I. N. 1975).

Oil seed situation in Odisha

Odisha farming is exceptionally packed in low beneficial and high water expending paddy development with little enhancements towards heartbeats, oilseeds and other high worth harvests Reddy A. A. (2013). Patnaik and Nayak (2014) found that zone, yield and creation of oilseeds in Odisha enlisted negative development during 1993-2004 while the period 2004-2011 experienced great development of oilseed generation in the state. This wonder has happened over the four physiographic zones of Odisha for example Northern level, Central table land, Eastern Ghat and Coastal fields. This may be because of harvest broadening for high profitable business crops. Other than the cultivators have embraced innovation serious practices, utilization of HYV seeds for accomplishing larger amount of creation. Anyway with the coming of present day innovation and advancement there has been vacillation in farming generation rendering as exceptional discussion on rural development and shakiness in India. Since it has direct ramifications for sustenance supply the board and large scale monetary steadiness (Chand & Raju 2009). Insecurity underway and efficiency of Indian rural in connection to green insurgency has been strongly learned at total level and there are opposing perspectives with respect to the effect of green transformation on flimsiness. A few examinations (Hazel 1982; Rao et al. 1988) have inferred that flimsiness has expanded in Indian horticulture during post green upheaval period because of reception of present day innovation. The opposing proof has been propounded by the examinations like Mahendra Dev (1987), and Chand and Raju (2009) who have reasoned that the insecurity has declined during the post green unrest period. Paltasing et al (2013) examined development and precariousness in subsistence agribusiness in Odisha (Paltasingh & Goyari 2013).

REFERENCES

Anjum FM and Hussain S. (2007). Flaxseed (linseed), a valuable grain: a review. Food Australia. 59(12): 597-601.

Athar M and Nasir SM. (2005). Taxonomic perspective of plant species yielding vegetable oils used in cosmetics and skin care products. African journal of biotechnology. 4(1): 36-44.

Aubourg P, Adamsbaum C, Lavallard-Rousseau MC, Rocchiccioli F, Cartier N, Jambaque I & Bougneres PF. (1993). A two-year trial of oleic and erucic acids ("Lorenzo's oil") as treatment for adrenomyeloneuropathy. New England Journal of Medicine. 329(11): 745-752.

Babu CR. (1977). Herbaceous Flora of Dehra Dun.

Banerji R and Mitra R. (1996). Mahua (Madhuca species): uses and potential in India. Appl. Bot. 16: 260-277.

Berglund DR, Ashley R and Bradley CA. (2007). Sunflower Production (Introduction only).

Berti M, Johnson B, Gesch R and Forcella F. (2007). Cuphea plant nitrate content and seed yield response to nitrogen fertilizer. Issues in New Crops and New Uses, ASHS Press, Alexandria, VA.

Boland M and Stroade J. (2004). Sunflower profile. Agricultural Marketing Resource Center (Ag-MRC). http://www. agm rc. org/agm rc/com m odity/grainsoilseeds/sunflower/sunfl owerprofile. htm (Accessed March 2005).

Chakrabarty MH. (1980). Oil Technology Association India. 12: 114-120.

Chand R and Raju SS. (2009). Instability in Indian agriculture during different phases of technology and policy. Indian Journal of Agricultural Economics. 64(902-2016-67296).

Chand R and Raju SS. (2009). Instability in Indian agriculture during different phases of technology and policy. Indian Journal of Agricultural Economics. 64(902-2016-67296).

Čmolík J and Pokorný J. (2000). Physical refining of edible oils. European Journal of Lipid Science and Technology. 102(7): 472-486.

Dagne K and Jonsson A. (1997). Oil content and fatty acid composition of seeds of Guizotia Cass (Compositae). Journal of the Science of Food and Agriculture. 73(3): 274-278.

Dawodu FA. (2009). Physico-chemical studies on oil extraction processes from some Nigerian grown plant seeds. Electronic Journal of Environmental, Agricultural and Food Chemistry. 8(2): 102-110.

Gesch RW, Barbour NW, Forcella F and Voorhees WB. (2002). Cuphea growth and development: responses to temperature. Trends in new crops and new uses. ASHS Press, Alexandria.

Giuffre F, Neri A, Poiana M, Mincione B, Tripodi G, Villari R and Gioffre, D. (1996). Tung oil (Aleurites moluccana, Willd). Note I: Characteristics of the lipidic fraction and prospective utilization. Riv. Ital. Sostanze Grasse. 73(10): 475-478.

Graham SA, Hirsinger F and Röbbelen G. (1981). Fatty acids of Cuphea (Lythraceae) seed lipids and their

systematic significance. American Journal of Botany. 68(7): 908-917.

Gupta RK. (1989). The living Himalayas. Volume 2. Aspects of plant explorations and phytogeography. Today & tomorrow's printers & publishers, New Delhi(India). 1989.

Hall C, Tulbek MC and Xu Y (2006). Flaxseed.In L.T. Steve (ed.), Advances in Food and Nutrition Research, Academic Press: New York.

Hazel PB. (1982). Instability in Indian Foodgrains Production (No. 30). IFPRI Research Report.

Hunter J and Roth G. (2010). Camelina production and potential in Pennsylvania, Agronomy Facts 72. College of Agricultural Sciences, Crop and Soil Sciences, Pennsylvania State University.

India, N. I. N. (1975). Annual Report, Jan., 1974 to Dec. 1974. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research, Govt. of India.

Knapp SJ. (1990). New temperate oilseed crops. Advances in new crops. 203-210.

Lafferty RM, Rife C and Foster G. (2009). Spring camelina production guide for the Central High Plains. Golden, CO: Blue Sun Agriculture Research & Development, 14143.

Mahendradev S. (1987). Growth and instability in foodgrains production: an inter-state analysis. Economic and Political weekly. A82-A92.

McVay KA and Lamb PF. (2008). Camelina Production in Montana, Montana State University Extension. Field Crops, D-16.

O'Brien RD. (1998). Fats and oils: formulating and processing for applications. Lancanter.

Odoemelam SA. (2005). Proximate composition and selected physicochemical properties of the seeds of African oil bean (*Pentaclethra marcrophylla*). Pakistan Journal of Nutrition.

Oommen TV and Claiborne CC. (1999). U.S. Patent No. 5,949,017. Washington, DC: U.S. Patent and Trademark Office.

Oplinger ES, Hardman LL, Gritton ET, Doll JD and Kelling KA. (1989). Canola (Rapeseed), Alternative Field Crops Manual. 7 pp. Un. Of Wisconsin, Extension, Cooperative Extension, Madison. WI. 53706.

Paltasingh KR and Goyari P. (2013). Analyzing growth and instability in subsistence agriculture of Odisha: evidence from major crops. Agricultural Economics Research Review. 26(conf). 67-78.

Patel M, Pradhan RC and Naik SN. (2011). Physical properties of fresh mahua. International Agrophysics. 25(3): 303-306.

Pattanaik F and Nayak NC. (2014). Agricultural Growth in Odisha During 1970-2012: An Analysis. IUP Journal of Applied Economics. 13(1).

Pengilly NL. (2003). Traditional food and medicinal uses of flaxseed. In Flax (pp. 264-279). CRC Press.

Pioch D and Vaitilingom G. (2005). Palm oil and derivatives: fuels or potential fuels?. Oléagineux, Corps gras, Lipides. 12(2): 161-169.

Putnam DH, Budin JT, Field LA. and Breene WM. (1993). Camelina: a

promising low-input oilseed. New crops, 314, 322.

Rabasco Álvarez AM and González Rodríguez, M. L. (2000). Lipids in pharmaceutical and cosmetic preparations. Grasas y Aceites. 51 (1-2): 74-96.

Rao CH, Ray SK and Subbarao K. (1988). Unstable agriculture and droughts: implications for policy.

Raymer PL. (2002). Canola: an emerging oilseed crop. Trends in new crops and new uses. 1: 122-126.

Reddy A. (2013). Agricultural productivity growth in Orissa, India: Crop diversification to pulses, oilseeds and other high value crops. African Journal of Agricultural Research. 8(19): 2272-2284.

Schoellhorn R., Warm Climate Production of Cuphea species for Florida. Commercial Floriculture Update. University of Florida, 2004.

Schwab AW, Bagby MO and Freedman, B. (1987). Preparation and properties of diesel fuels from vegetable oils. Fuel, 66(10), 1372-1378.

Sediqi M N (2012). Adaptability of oilseed species at high altitudes of Colorado and technology transfer to Afghanistan. 2000-2019-CSU Theses and Dissertations.

Singh IS. (1998). Mahua An oil bearing tree. Technical Bulletin, ND University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India, 3-11.

Singh, K. N., & Gupta, P. N. (1979). Working Plan for the East Dehra Dun Forest Division, Uttar Pradesh (1979-80 to 1988-89).

Singh S, Singh AK, Apparao VV, Bagle B G and Dhandar DG. (2005). Genetic Divergence in Mahua (Bassia latifolia) under Semi-Arid Ecosystem of Gujarat. Indian Journal of Plant Genetic Resources. 18(3): 244-249.

Upadhaya M. and Upadhaya N.K., Working Plan, Garhwal Van Prabhagh (1981-82 to 1990-91), (1980), pp . (xvi).

Vaisey-Genser M and Morris DH. (2003). Introduction: history of the cultivation and uses of flaxseed. In Flax (pp. 13-33). CRC Press.

Zohary D and Hopf M. (2000). Domestication of plants in the Old World: The origin and spread of cultivated plants in West Asia, Europe and the Nile Valley (No.Ed.3).Oxford University Press.