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RESEARCH ARTICLE

METHODOLOGY IN ORGANIC FARMING

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ABSTRACT

Organic farming is a knowledge intensive system and has been developed by practitioners themselves over the years. Organic farming is one such system which provides healthy and safe food without ecological harm. Hence, the Indian Government started promoting organic farming through various schemes like National Project on Organic Farming (NPOF), National Horticulture Mission (NHM), Rashtriya Krishi Vikas Yojana (RKVY) etc. This farming is a modern and a sustainable form of agriculture that provides consumers fresh natural farm products. Organic farming works in synchronization with nature. The objective is achieved by using techniques to improve crop yields without harming the natural environment as well as the people who live and work in it. Organic agriculture offers an exclusive amalgamation of environment-friendly practices, which require low external inputs, thereby contributing to increased food availability. It has a very positive influence especially on birds, insects, weeds, wildlife, and soil flora and fauna. As compared to conventional agriculture, organic farming produces cost-effective food products, free of synthetic fertilizers and pesticides. It also provides employment opportunities and economic benefits to local communities. Organic systems give higher animal immunity and increased disease resistance to plants, with 50 % less mycotoxins in crops and a persistent shelf life. This Chapter emphasizes on use of bio-pesticides in place of chemical agents and drugs that are not only harmful for the environment but they also enter inside the food chain through the edible products and then by biological magnification continuously go on increasing in percentage. There are various plants that have potential in being used as insecticidal agents and they can prove to be an arsenal in crop management both post and pre-harvesting. Farmers need an awareness to use these biological agents as tools to enhance productivity and also increase their profits over time rather than spending heavy amounts on toxic chemicals that deteriorate the soil quality and make it unfit for future farming practices.

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INTRODUCTION

Organic farming sometimes referred to as ecological farming or biological farming. It is a type of agriculture that emphasises crop rotation and companion planting while using organic fertilisers. It also emphasises the cultivation of plants and the natural breeding of animals. In order to maintain soil fertility and ecological balance and to reduce waste and pollution, this procedure uses organic components instead of synthetic ones. Genetically engineered animals are not allowed in organic farming.

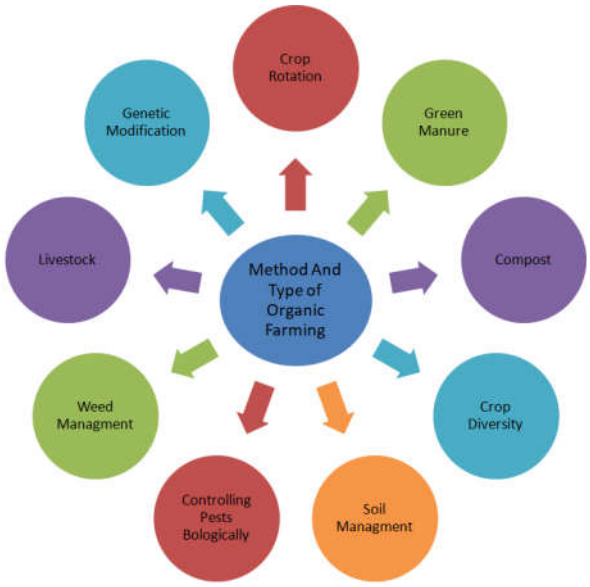
Type of Organic Farming: Organic farming can be divided into two categories: Pure organic farming and integrated organic farming. Both advantages and disadvantage can be found in these farming methods. Some farmers choose using a refined farming method, while others choose an integrated farming method.

Pure Organic Farming: This farming method cultivates using natural methods, as its name suggests. Inorganic chemicals that could harm the land, the crop, and the humans who consume it are absolutely avoided in pure organic farming. Farmers utilise bio-pesticides and organic fertilisers made from natural sources in this procedure.

Integrated organic farming: The integrated farming process consists of integrating pest management and nutrients management to achieve ecological requirements and fulfil the economic demands. Residue recycling, bio-intensive farming, high-tech horticulture, mushroom, dairy, poultry, fisheries, apiary, etc. are all aspects of integrated organic farming systems (IOFS), which can also increase growers' income and livelihood security.

Organic Farming Techniques or Methods: In order to improve the soil's health, organic farming strives to cultivate the land and raise crops in a certain way.

The emphasis is on growing nutrient-dense crops. For organic farming, a variety of methods are used. These methods include:



CROP ROTATION: Crop rotation is an agricultural practise in which farmers grow various crops in alternate years on the same plot of land in order to preserve the soil's health. Crop rotation is a highly advantageous farming method that replenishes the soil naturally by having various plants provides various nutrients to the soil. By destroying their habitat, this method aids in the control of pests, weeds, insects, and other things.

GREEN MANURE: Green manure refers to dead plants that have been uprooted and added to the ground as dirt. These plants provide minerals to the soil, enhancing its fertility. The main advantages of using green manures in a crop rotation system are the addition of organic matter and nitrogen, the conservation of nutrients, and the protection of the soil surface during seasons when erosion is more likely to occur.

COMPOST: One of the best natural fertilisers for organic farming is compost. It is a highly nutrient-rich recycled organic material that improves crop output and soil quality. A combination of substances called compost is used to fertilise plants and enhance the physical, chemical, and biological qualities of soil. Decomposing plants, food waste, recycling organic materials, and manure are frequently used in its preparation. The resulting combination is teeming with helpful bacteria, protozoa, nematodes, and fungi as well as plant nutrients. Compost increases soil fertility in horticulture, urban agriculture, gardening, landscaping, and organic farming, reducing reliance on synthetic chemical fertilisers. (Kogel-Knabner *et al.,* 1988) Compost offers crops nutrients as fertiliser, acts as a soil conditioner, increases the amount of humus or humic acid in the soil, and introduces helpful bacteria that help to suppress pathogens in the soil and lower the incidence of diseases that are transmitted through the soil.

CROP DIVERSITY: These days, a new practise known as "Polyculture" is popular. To meet the rising demand for food products around the world, polyculture allows for the simultaneous cultivation of a number of crops. Traditional farmers, on the other hand, were accustomed to using "monoculture or the cultivation of only one type of crop in a certain area. In order to increase productivity, the polyculture farming technique also aids in the creation of essential soil microbes.

SOIL MANAGEMENT: The main necessity for farming is soil. After crops are grown, the soil loses nutrients, which lowers its quality. Therefore, it is essential to maintain the soil to replenish the soil's nutrients. The primary goal of organic farming is to improve soil quality through the use of natural methods. Because of this, organic farming places a strong emphasis on employing bacteria that are found in animal faeces and that work to enrich the soil with nutrients to enhance yields.

CONTROLLING PEST BIOLOGICALLY: Numerous organisms live on agricultural land. Some of these creatures aid in the production of crops, while others are detrimental to the crop because they interfere with it. To keep the soil fertile and ensure the safety of the crops, we also need to restrict the growth and population of hazardous organisms. So, to control pests naturally, organic farmers can employ gentle (containing fewer chemicals) or natural herbicides and pesticides. To effectively prevent hazardous organisms in the field, farmers can also adequately clean the farm.

WEED CONTROL: In agricultural fields, unwanted plants like weeds and wild grass grow alongside the crops. The majority of the soil's nutrients are sucked up by these weeds, which has an impact on crop growth. Rather than trying to completely eradicate weeds, organic agricultural methods try to slow down their growth. In organic farming, we mostly utilise mulching, mowing, or cutting as weed control measures. Farmers employ plastic films or plant leftovers as mulch to prevent weed growth on the soil's surface. On the other hand, cutting or mowing is a practise that reduces weed development in the field by removing it. Thus, weed management strategies aid in enhancing crop development.

LIVESTOCK: Livestock makes a significant supplementary contribution. Animal products such as meat, milk, eggs, and poultry provide farmers with daily monetary income and essential nutrients through pulling power, manure, fuel, and as fertiliser. The greatest class of livestock systems in terms of the quantity of animals, production, and consumers it serves. Animals are essential to the operation of the farm and provide livestock products (meat, milk, eggs, wool, and hides) as well as the ability to quickly generate cash in times of need. Animals convert plant energy into usable activity, including tasks like transport, milling, and logging, building roads, marketing, and raising water for irrigation. Animal power is also employed in operations like forestry and road construction.

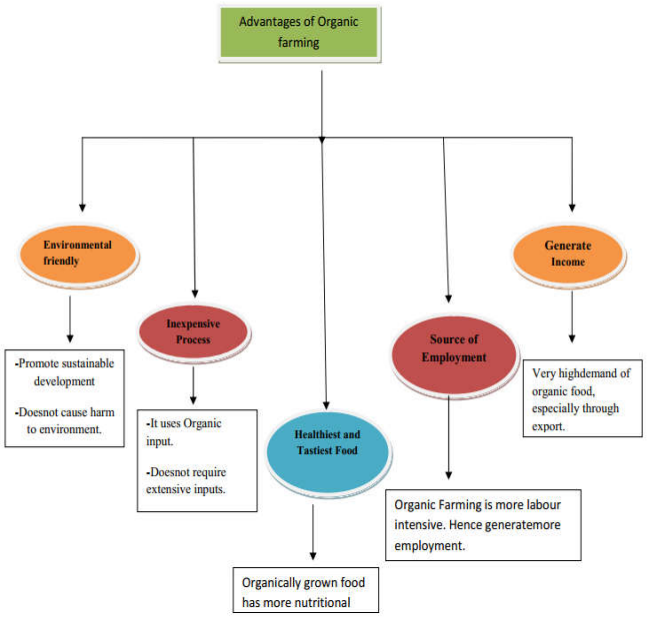
GENETIC MODIFICATION: The fundamental goal of organic farming techniques is to improve soil quality and crop output through natural means. Therefore, we should avoid using genetic alteration in organic farming. However, it should be emphasised that the seed stocks used for organic farming contain pollen from transgenic crops as well. As a result, it is very difficult to totally avoid genetic modification in organic farming.

Advantages of Organic Farming

There is various advantage of Organic Farming which is as follows:

- Ecological friendly: It promotes sustainable development. All raw materials are provided by the environment and get back mixed with the environment at last. The substances or material used for organic farming donot cause any harmful impact on the environment.
- Inexpensive Process: The substance or products used in or obtained from organic farming are harmful they are pure organic in nature and the beauty of organic farming is that it doesnot require expensive input.
- Healthiest and tastiest food: Organically grown food has more nutritional value due to which there is enhancement in food taste also.
- Source of employment Organic Farming is morelabour Intensive hence generate a great opportunity for employment.
- Generate Income: Due to high nutritional value the demand of organic food is very high especially through export which generate good income source.

Necessity Organic farming: In order to increase productivity and satisfy global food demand, agricultural activities are increasingly involving the use of chemicals.



The chemicals we use as pesticides and fertilisers gradually disintegrate into water streams and also seep deeply into the soil. All of this raises the pollution level, whether it is soil pollution or water pollution. In order to assist the earth heal organically, we now need to convert to another farming method, such as organic farming. To reduce the use of chemical-based fertilisers, pesticides, and other agricultural products, it should be our top goal to promote organic farming today. Additionally, organic farming is among the finest solutions for enhancing soil quality without the use of any potentially dangerous chemicals.

The Bigger Question: Pesticides and organic farming?: Weeds and pests are typically kept under control in a well-managed organic farming system, and are therefore regarded as a natural component of the system. Predators show up in agricultural eco-systems as they do in nature, and provided they are not disturbed, they seem to do a fine job.Many organic farmers hold the opinion—possibly correctly—that no pesticides should be used, not even those that are natural or biological. Many farmers utilise preventative measures like diluted cow urine and vermiwash, which is the liquid from a vermicompost tank, both of which are also effective as insecticides in higher concentrations. Excellent preventative measures can be used on a farm using Panchakavya. There are several non-chemical techniques of pest control available for situations where preventative measures are ineffective and insect populations have grown to the point where economic damage is occuring. These are as follows:

- Removing the bug by manually (For example the pest is a large caterpillar)
- Using pheromone traps
- Light traps are used (for moths and other insects)
- Making use of predatory species (a point of debate)
- The application of biological and microbiological insecticides such as Spodoptera, Heliothis, Trichoderma and Trichogramma.
- Raising trap crops (e.g. Mustard with cabbage; Maize around cotton)
- Using natural pesticides that can be quickly prepared. Several plants can be utilised to make natural bio-pesticides. Among the various plants that are frequently employed in pest management are neem, ginger, chilli, *Vitex negundo* (Indian pivet tree), custard apple (the seeds), *Pongamia pinnata* (pongam/karanj), asafoetida, turmeric, garlic, sweet flag, tobacco, tulsi, nux vomica, and Persian lilac. There must be a unique preparation for each pest.

Plant part used as insecticide: Rhizome

List of Botanical Commercial plants with their Insecticidal, Pesticidal Properties

Common name: **Neem**
Scientific name: *Azadirachta indica*A. Juss.
Part used as insecticide: oil extracted from the seeds, neem bark, and neem leaf

Common name: Ginger
Scientific name: *Zingiber officinale*Roscoe
Plant part used as insecticide: Rhizome

Common name: Chilli
Scientific name: *Capsicum annum*L.
Plant part used as insecticide/ pesticide: Leaves and fruit

Common name: Custard apple
Scientific name: *Annona reticulate*L.
Plant part used as insecticide/ pesticide: Oil extract from seed

Common name: Chinese charte tree
Scientific name: *Vitex negundo* L.
Plant part used for insecticide/ pesticide: essential oils from leaves.

Common name: Indian beech.
Scientific name: *Millettia pinnata* (L.) Panigrahi
Plant part used for insecticide/ pesticide: Seed oil.

Common name: Haldi
Scientific name: *Curcuma longa* L.
Plant part used as insecticide: Fresh Juice, Rhizome Powder, and leaf essential oil.

Common name: Garlic
Scientific name: *Allium sativum* L.
Plant part used as insecticide:essential oils of seed and fruit.

Common name: Sweet flag
Scientific name: *Acrorus calam* L.
Plant part used as insecticide: Essential oil for Rhizome.

Common name: Tulsi
Scientific name: *Ocimmum tenuiflora* L.
Plant part used as insecticide: Leaves and its essential oil

Plants: Pesticidal Effects

It is beyond a shadow of a doubt that a number of plants have pesticidal action, and studies by numerous research groups in various regions of the world have supported this. The survey conducted by Mwine *et al*., (2010) one of the most recent researches, revealed that traditional farming techniques in Southern Uganda use 34 species from 18 groups Additionally, Rajapake and Ratnasekera (2010) investigated the toxicity of ethanol extracts of the leaves of 20 plant species from various families to *Callosobruchus maculatus* and *Callosobruchus chinensis*. It was noted that mortality peaked 72 hours after exposure to the leaves' oils, indicating a significant level of lethality. Researchers Lajide *et al.*(1998) and Fatope *et al*.(1995) examined the ability of various indigenous Nigerian plants to repel the *Sitophilus zeamais Motsch* (maize weevil) and *Callosobruchus maculatus* F(cowpea weevil), respectively.

There have been very few natural insecticides developed over the past few decades, with the exception of *pyrethrum*, which has gained commercial and international recognition for its high effectiveness and broad-spectrum insecticidal activity (insects are both repelled and killed depending on concentration).Based on the findings of pesticide screenings, it has been determined that a number of plants have widespread pesticidal action. These plants are frequently utilised in traditional agricultural applications in many developing nations, especially in tropical regions.Although the lethality and amounts of the active components may vary, it has been determined through several experiments that activity is typically spread in most cases among the various portions of the same plant. (Rajapake and Ratnasekera, 2010). Plant *Azadirachta indica*, commonly known as neem tree. Over 25 distinct types of insect pests are successfully controlled by the plant in Nigeria and India.

Table 1. Plants with secondary metabolite and their mode of action

S.No.	Plant Name	Secondary metabolite as pesticide/ Insecticide	Properties and Work against
1.	*Adeniun obesum*(Forssk.) Roem.& Schult.	Chacals Baobab (Senegal)	Insecticidal particularly the larvae of ballworm.(Rajamani & Negi, 2021)
2.	*Azadirachta indica* A.Juss.	Azadirachtin/ Neem oil,Neem cake, neem powder, bionimbecidine (green fold)	Repellent, antifeedant, nematocide, sterilant(Benelli *et al.,* 2017)
3.	*Biden pilosa* L.	Polyacetylenes	Insecticidal and pesticidal against *Plutella xylostella* (L.) (Li *et al .,* 2021)
4.	*Cannabis sativa* L.	Cannabinoida, volatile terpenes, herein	Insecticidal, against Filariasis vector(*Culex quinquefasciatus)* aphid, tobacco cut worm (Benelli *et al.*, 2018)
5.	*Chrysanthemum cinerariaefolium*(Trev) Bocc	Pyrethrum/ pyrethrins	Insecticidal against crawling and flying insects such as Cockroaches, Ants, mosquitoes, termites.(Zito, 1994)
6.	*Lonchocarpus sp.*	Rotenone	Insecticidal, aphids, bean leaf beetles. (Chinou, 2008)
7.	*Nicotina tobaccum*L.	Nicotine	Insecticidal Aphids, thrips, antifungal, mites, bugs, fungus, gnat, leafhopper.(Keswani *et al.,* 2020)
8.	*Ryania speciosa*M. Vahl	Ryana	Insecticidal caterpillars, thrips, bettles, bugs, aphid, cotton, pests. (Lanner *et al*., 2010)
9.	*Schoenocaulon officinale* (Schltdl. &Cham.) A. Gray	Sabadilla dust	Insecticidal, Bugs, blister, beetal, flies, caterpillar (Hare,1996)
10.	*Tephrosa vogelli* Hook F.	Rotenone	Insecticidal, insect and lower animal forms (Lambert *et al., 1998*)
11.	*Artemisia annua* L.	Terpinoid	Pesticidal, pest *Pieris rapae* L.(Hasheminia *et al.,* 2011)
12.	*Jatropha curcas*L.	Alkalois, pyrethroid, terpinoid, Flavanoid	Repellent on insects, hinder feed, growth , reproduction potency of insects (Patel &Narasimhacharya, 2022)
13.	*Vernovia amygdalina* L.	Stigmostane steroidal saponins	Pesticidal, against Cowpea beetle (*Callosobruchus maculatus*) (Green *et al.,* 2017)
14.	*Lawsonia inermis* L.	Pesticidal	Beetle (*Tribolium castanum*)(Biswas et al., 2016)
15.	*Tagetes minuta* L.	Repellent	Repellent against beetal (*Tribolium castanum* and*Lasioderma serricorne)* (Zhang *et al., 2022)*

The presence of azadirachtin, which is more abundant in the kernel than in the leaves and other plant tissues, has been linked to the activity (Kulkarni *et al*., 2009 and Rajapake and Ratnasekera, 2010).Research was done on three different plants: *Rhododendron molle* G. Don, *Trpterygium forrestii* Loes, and *Milletia pachycarpa* Benth. The ground powder was particularly effective against caterpillars, body lice, plant lice, aphids, pentatomids, and leaf beetles when used as a spray, suspension, or dust. *R. molle,* one of the plants, showed specific toxicity to some species of pentatomids, leaf-beetles, and lepidopterous larvae. It was discovered that all three plants contained rotenone. When Sri Lankan plants were examined, it was discovered that three of them—*Pleurostylia opposita* (Wall) *Alston* (Celastraceae), *Aegle marmelos* Correa (Rutaceae), and *Excoecaria agallocha* (Euphorbiaceae)—had extracts that were insecticidal. The ethyl acetate extract of *E. agallocha* contains three compounds that were discovered to be insecticidal for the first time (Okwute, 2012; Wender *et al.,* 2011). These compounds have the daphnane orthoester structure. One of the most researched genera is certainly Piper (family Piperaceae). With over 1000 species, over 611 active chemicals have been extracted and identified from diverse portions of the species, and roughly 112 genera have been evaluated for pesticidal activity. Later, it will be discussed how important this coincidence is to the effectiveness and efficiency of biopesticides and crude medicines. Some researchers have conducted structure-activity relationships (SAR) investigations in an effort to increase the insecticidal action of piperine amides and have found that neither the pipenonyl group nor the isobutyl group, as previously reported, offer any special benefits.

Repellent and Insectisides: Some kinds of pesticidal agents with intriguing and unusual biological activity are closely related to insecticidal agents and occasionally employed in tandem with insecticides in pest management systems. Among them are attractants, deterrents that prevent animals from feeding, and insect repellents.

These classes will receive some consideration despite being much less prevalent in plant sources than insecticides. Depending on the dose, a certain insecticide may occasionally work as both an insecticide and a repellent. The main distinction between the two is that an insect repellent doesn't actually kill insects; rather, it simply keeps them away by releasing smelly vapours or showing mildly harmful effects (Rajapake and Ratnasekera, 2010). Particularly in underdeveloped nations, there is growing interest in the use of plant-based insect repellents. For instance, according to Seyoun *et al.*, (2002) the inhabitants of Western Kenya burn the plant species *Ocimum americana* L., *Lantana camara* L., *Tagetes minuta*, and *Azadirachta indica* A. Juss directly defeated the *Anopheles gambiae* S.S.Giles, the malaria vector

CONCLUSION

Based on conventional knowledge, the results of pesticide and phytochemical screenings of several higher plants clearly suggest that plants are endowed with pesticidal qualities that can be inexpensively exploited for application in agriculture and related industries. Because synthetic pesticides are so toxic and persistent, they endanger both people and the entire ecosystem, necessitating the development of plant-based alternatives. Additionally, they are too pricey for the impoverished farmers in the world's emerging nations. On the other hand, items made from plants are less expensive, biodegradable, and hence environmentally friendly. However, an agricultural programme that is primarily dependent on plant-based products must be supported by a rigorous research programme into novel plant sources. Traditional knowledge has so far directed studies on potentially active plants, and the results have largely validated the activity of a reasonable percentage of the plants. The findings also show that plants from specific plant groups are more likely to exhibit pesticidal activity.

As a result, these findings will be effective guides in the gathering of plants for laboratory and field research projects. Large-scale field use of botanic agricultural pesticides requires a sufficient and consistent supply of suitable plants to the areas in need. This indicates that, because plants thrive best in their natural habitats, efforts should be made to invest in large-scale cultivation of such plants in their varied regions, as is done in China, Japan, and Kenya. This will be of significant economic benefit in developing countries; as such programmes can lead to economic empowerment of poor farmers, ultimately improving the economies of these countries.

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