Organic Potato Cultivation

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भाकृअनुप
ICAR

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Estd. 1949
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ISO 9001:2015

Organic farming emerged as an alternative agricultural system for producing healthy food without deteriorating the environment. More and more cultivable area and crops are coming into the ambit of organic agriculture with refinement in agro-technologies and demand of consumers. Like other crops, organically produced potatoes will have accelerated demand in future in domestic and international markets. Unique agro-ecological advantages enable India to grow organic potatoes round the year to sustain the supply chain in the internal market as well as for export. Processing of organic potatoes into healthy products will further boost the organic cultivation of this crop. At present, India is the second-largest producer of potatoes in the world with production of 51.3 million tonnes from 2.14 million hectares' area and maintaining an average yield of 24.0 t/ha. So, ample scope is there for diversifying some acreage for organic potato production. Different regions of the country like Indo-Gangetic plains; northern, eastern and southern hills; and plateau region have huge potential for growing organic potatoes. ICAR-Central Potato Research Institute has standardized organic potato production technology after a decade of intensive experimental work that ensures the realization of the sustainable marketable yield of 25-30 t/ha. The technology is briefly described in this folder.

Pre-requisites of National Standards for Organic Production (NSOP): For organic potato production standards of NSOP are to be met for getting a certificate for the produce from certification bodies. It consists of several components which should be complied by potato growers. Organic potato production plan must be developed having diverse planting schemes (crop rotation, cover crops, green manures, intercropping etc.). Organic farms are required to maintain sufficient diversity by taking into account the intensity of weeds, diseases and pests. Improving soil organic matter, fertility, microbial activity and general soil health is the basic norm for achieving optimum yield. Relevant measures must be taken to prevent soil erosion, salinization, excessive and improper use of water and pollution of ground or surface water. Clearing of land by burning organic matter or other is restricted to a minimum, while clearing of primary forest is totally prohibited. Encouraging biodiversity and nature conservation is another principle of organic farming and its certification has defined standards for all types of farm. Records of all farm operations, inputs used, their storage and handling, and storage of produce must be maintained. Physical barriers must be created between organic and inorganic fields to avoid mixing and contamination. When farmers decide to start organic agriculture, the initial transition phase is termed as 'conversion period', which is counted from the day of the first inspection by the certification agency. It is

essential for establishing an organic management system and soil fertility built up at the farm site. A holistic site-specific plan is prepared for converting a conventional farm into an organic one by adhering to all NSOP standards. This period is of at least two years before the start of the production cycle and the certification body may decide for extension or reduction of conversion period depending on past land use and the surrounding environment. During this period, farm produce shall be properly labelled and sold as "produce of organic agriculture in conversion".

National Programme on Organic Production (NPOP) norms for weed, pest and disease management: Basic requirements of NPOP for weed, pests and disease control should be met sincerely to avoid rejection of produce. Emphasis should be given on proper land preparation, appropriate variety, balanced use of nutrients, crop rotation, green manuring, inter-cropping, mulching etc to minimize losses below the economic threshold level from these menaces. Natural enemies of pests and diseases should be protected and encouraged through proper habitat development by growing hedges and maintaining nesting sites. An ecological equilibrium is achieved in the pest-predator cycle. Products prepared at the farm level from local plants, animals and micro-organisms are permitted for their control. Thermic weed control and physical methods for pests, diseases and weeds management are permitted. Thermic sterilization of soils to combat pests and diseases are restricted in circumstances where a proper rotation or renewal of soil cannot take place. All equipment from conventional farming systems must be properly cleaned and free from residues before being used in organic fields. Use of synthetic herbicides, fungicides, growth regulators, synthetic dyes, insecticides and other pesticides are prohibited. Genetically engineered organisms or products are also prohibited in organic cultivation. Farmers have to maintain product content and use records for inspection by the certification body.

Organic potato production technology: Refinement in production technology suitable for organic cultivation including variety, seed and its preparation, land preparation, planting, crop geometry, nutrient management, crop rotation, green manuring, composting/ vermicomposting, water management, inter-culture and weed control, pest and disease management and harvesting is discussed in points described below:

Variety: NSOP norms suggest that varieties in organic farming should be adapted to local soil and climatic conditions, and should be resistant to pests and diseases. Genetic diversity should be taken into consideration while choosing varieties of different crops in a crop scheme of a farm. Promising potato varieties suitable for plains and hills are mentioned in the following Tables.

Table 1: Promising potato varieties under organic farming in plains

Variety	Tuber yield (t/ ha)		Duration (Days)	Resistance	Tuber Characters
	Marketable	Total			
Kufri Khyati	28.4	31.4	70-80	Early and late blight	White cream, ovoid tubers, medium eyes, cream flesh
Kufri Mohan	28.3	29.9	90-100	Late blight	White-cream ovoid tubers, shallow eyes, white flesh
Kufri Garima	27.0	29.3	90-100	Late blight	Light yellow, ovoid tubers, shallow eyes, light yellow flesh
Kufri Pushkar	26.1	27.9	90-100	Late blight, wart	Yellow, ovoid tubers, medi um-deep eyes, cream flesh
Kufri Sadabahar	26.0	27.0	90-100	Late blight, wart	White cream, ovoid tubers, shallow eyes, white flesh
Kufri Anand	26.0	27.6	90-100	Late blight, wart, tolerant to frost and hopper	White cream, oblong tubers, shallow eyes, white flesh
Kufri Himsona	21.5	26.0	110-120	Late blight and wart	White-cream, round tubers, shallow eyes, cream flesh, suitable for chip making
Kufri Chipsona-3	20.3	23.1	100-110	Late blight	White cream, ovoid tubers, shallow eyes, white flesh, suitable for making chips

Table 2: Potato varieties for hills

Variety	Adaptability	Maturity	Yield (t/ha)	Resistance	Tuber Characters
Kufri Girdhari	Indian hills	100-110	30-35	Late blight	White cream, ovoid tubers, shallow eyes, white flesh
Kufri Himsona	Indian hills	110-120	25-30	Late blight, wart,	White-cream, round tubers, shallow eyes, cream flesh. Chipping variety
Kufri Himalini	North Indian hills	90-100	30-35	Late blight	White cream, ovoid tubers, medium-deep eyes, cream flesh
Kufri Jyoti	Indian hills	90-100	25-30	Early and late blight, immune to wart	White-cream, ovoid tubers, shallow eyes, cream flesh
Kufri Mehga	Northeastern hills	90-100	25-30	Early and Late blight	White-cream, ovoid tubers, medium- deep eyes, cream flesh
Kufri Shailja	North Indian hills	90-100	30-35	Late blight	White-cream, ovoid tubers, shallow eyes, white flesh
Kufri Swarna	South Indian hills	90-100	30-35	Early and late blight, wart, cyst nematode	White-cream, ovoid tubers, shallow eyes, white flesh

Potato seed: NSOP guidelines for all seed/ planting material prescribes that it should be certified organic. If such material is not available, then chemically untreated conventional seed/ planting material may be used. The seed must be procured from a reliable source and replaced within 3-4 years. Use of genetically engineered seed, transgenic plants or plant material is not allowed in organic farming. In potato crop, healthy seed potatoes can be produced by integrating eco-friendly methods for reducing vector (aphid) population below critical limits (20 per 100 compound leaves). Monitoring of aphids is done by placing a yellow water trap. Twelve yellow coloured sticky traps per ha are placed 8-10 days after planting for trapping whitefly and aphids. Height of traps should be adjusted to canopy height. Dried neem leaves are used as mulch in organic plots to reduce the insect population by their decomposition and repellent action. Weekly foliar spray of horticulture mineral oil @ 0.5% is done for reducing whitefly and aphid build up. Light traps developed by ICAR-VPKAS, Almora and ICAR-NCIPM, New Delhi are used to capture moths of several leaf-cutting caterpillars.

Seed preparation: Seed tubers are withdrawn from cold store 10-15 days before planting and kept in a diffused light under shade with proper ventilation for better sprouting. These can be kept in baskets, wooden boxes and plastic trays or may be spread in a thin layer on the floor.

Land preparation: In plains, sub-soiling in the initial phase of organic farming is better for soil loosening. It is performed during May- June for breaking hardpan just below the plough layer. In later stages, higher soil organic carbon and fauna activity keep soil sufficiently aerated and loose for better root development. Pre-planting irrigation is applied 7-10 days before field preparation in case of low soil moisture. Plough the field with a mouldboard plough or disc harrow up to a depth of 20-25 cm followed by one or two tilling and cross planking. The field should have fine tilth and levelled for efficient use of irrigation water and proper drainage. In hills, the soil is ploughed one month before planting and exposed to sunlight to destroy soil-borne pest and pathogens. Lime @ 300 kg/ha and *neem* cake @ 300 kg/ ha along with other organic manure is applied before second ploughing and planting is done after 15-20 days. Last ploughing and planking is done 1-2 days before planting.

Planting time and spacing: In plains, optimum planting time starts with maximum day temperature reaching below 32°C. The main season ranges between October to November starting from west to eastern zone. Row-to-row and plant-to-plant spacing is kept at 67.5 cm and 20-35 cm, respectively. Plant-to-plant spacing varies with seed size. Medium seed size tubers (35-45 mm) are planted at 20 cm spacing. Planting depth is maintained at 8-10 cm. Bed planting (two/ three-row; base 132 cm) is followed in micro-irrigation. In hills, summer (February- July) and autumn (August- November) are two distinct planting season. In hills, summer planting started from the third week of February and autumn planting started from last week of August. Ridges and furrow method is suitable for potato planting with a plant spacing of 60 x 20 cm. Optimum seed size tuber is 30- 50g and it is better to plant medium size tubers in organic cultivation.

Mulching: This is very effective in controlling weeds, conserving soil moisture and decomposing organic residues in soil. Crop residue, dry straw, dry grasses, plant leaves, pine needles and other vegetative material may be utilized for this purpose. Plastic mulching is also permissible in organic agriculture as it is removed from the field after use either for re-use or disposal as per guidelines of the certification body.

Nutrient management: Nutrient management strategy should avoid nutrient losses, accumulation of heavy metals and other pollutants. As per NSOP norms, only on-farm produced microbial, plant or animal origin biodegradable materials are used for plant nutrition. The outside material is used with restrictions. Non-synthetic mineral fertilizers are also regarded as a supplementary source. Restrictions are there for their use such as mineral potassium, magnesium fertilizers, trace elements etc. Manures containing human excreta are prohibited for preventing transmission of pests, parasites and pathogens in food. All synthetic nitrogenous fertilizers are prohibited. Application of well-decomposed biogas slurry, farmyard manure, compost, vermicompost, crop residue recycling and any safe organic source is beneficial for potato crop. Example of food grain and vegetable-based organic potato cropping system is mentioned in Table 3 & 4 for plains. In hills, apply well decomposed FYM @ 20t/ha + bamboo leaves ash @ 2.5 t/ha + rock phosphate @ 140 kg/ha or vermicompost @ 12 t/ha + bamboo leaves ash @ 2.5 t/ha + rock phosphate @ 140 kg/ha or organic poultry manure @ 7.5 t/ha + bamboo leaves ash @ 2.5 t/ha + rock phosphate @ 140 kg/ha at planting. Apply dry powder form of cow dung/ FYM @ 5 t/ha at earthing up. Use of bio-fertilizers is beneficial in organic agriculture. Apply *Azotobactor/ Azospirillium*, Phosphate Solubilizing Bacteria (PSB) and Potash Mobilizing Bacteria as a seed treatment or Apply *Azotobactor/ Azospirillium* @ 2.5 kg/ha, PSB @ 2.5 kg/ha and Potash mobilizing bacteria @ 2.5 kg/ha as a soil application at planting. Purchase bio-fertilizers from reliable sources and maintain its information for evaluation and certification.

Crop rotation: Potato is a shallow-rooted exhaustive crop, so, preceding and succeeding crops in an organic-based cropping system should be deep-rooted, less nutrient and water demanding. At least one leguminous, vegetables or green manure crop should be included in the system. Continuous cultivation of potato crop is avoided to reduce disease and pest build-up, so, a 2-3 year crop rotation may be adopted. Potato growers can choose potato cultivars and adjust crop duration suitable to their overall farming situation. The decision is taken similarly for other crops included in cropping/ inter-cropping systems. Studies conducted at this institute found crop sequences of maize-potato- onion, groundnut- potato- green gram, basmati rice- potato- late wheat, cowpea (vegetable)- potato- okra and groundnut- potato- maize+ green gram as promising in west-central plains. In hills, crop sequence is affected by altitude, the direction of slope and availability of irrigation water. In north-western & central hills, potato- vegetable pea, potato- radish, potato-turnip, potato- carrot, potato- fenugreek, potato- spinach, maize- toria- potato, maize- vegetable pea- potato, potato+ French bean, potato+ maize, potato+ garlic are better cropping/ inter-cropping systems. Promising rotations in northeastern hills are rice- potato, maize- potato, radish- potato, cauliflower- potato,

cabbage- potato, potato- beans, potato- barley and rice- potato- green gram. Maize-potato is a common system in north Bengal and Sikkim hills. In southern hills, potato-cabbage, potato- carrot, potato- radish, potato- cabbage- radish and potato + French bean are suitable potato based cropping system for organic agriculture.

Green manuring: This practice improves productivity, enhances soil fertility and controls weeds, pests and diseases. It also helps in reducing the incidence of soil-borne diseases like black scurf and common scab etc. in potato crop. Sesbania, sunhemp, cowpea and brassica etc. should be adjusted in crop plan of a field. Green manure crop should be incorporated in soil 40-50 days after sowing for its proper decomposition.

Composting and vermicomposting: Composting of crop residues and preparation of vermicompost is a common and very useful technique for utilization of farm waste into crop nutrition. This is an invariably indispensable part of organic farming. Several available methods can be used for this activity.

Table 3: Example of doses and method of application for food grain-based organic farming system

Nutrient management	Groundnut	Processing potato	Maize + green gram
Conventional inorganic system	25 N-50 P_2O_5-50 K_2O kg/ha; Band placement	270 N-80 P_2O_5-150 K_2O kg/ha; Band placement and broadcasting	150 N-80 P_2O_5-80 K_2O kg/ha; Band placement and broadcasting
Integrated organic system	Maize+ moong bean stover: Approx. 15-19 t/ha; *in situ* incorporation + *Rhizobium, Bacillus* subtilis, *Trichoderma*; seed treatment & mixed with FYM + FYM (2 t/ha)+ vermi-compost (1 t/ha); FYM before sowing, vermi-compost at sowing	Groundnut stover: Approx. 5-10 t/ha; *in situ* incorporation + *Azotobacter, Bacillus subtilis, Trichoderma*; seed treatment & mixed with FYM+ FYM (15 t/ha)+ vermi-compost (6 t/ha); FYM before planting, vermi-compost at earthing	Potato haulms: Approx. 4-7 t/ha; *in situ* incorporation + *Azotobacter, Rhizobium, Bacillus subtilis, Trichoderma*; seed treatment & mixed with FYM+ FYM (6 t/ha)+ vermi-compost (3 t/ha); FYM before sowing,vermi-compost at 30-35 days
Organic system (Biofertiliser/ microbial formulation): *Rhizobium* (250g/ha seed treatment), *Bacillus subtilis* (250g/ha seed treatment), *Azotobacter* (250g/ha seed treatment), *Trichoderma* (4 kg/ha with 100 kg FYM for mixing in soil)			

Water management: Potato is sensitive to water stress, and stolon formation and tuber initiation are critical stages. In plains, irrigation is applied at 8-10 days' interval in the initial phase and it is increased to 12-15 days during winter in flood method. Around 50 mm water is applied in each irrigation. Watering is stopped 10-12 days before haulm cutting for better skin setting. Experiments on organic farming have shown better

Table 4: Example of doses and method of application for vegetable-based organic farming system

Nutrient management	Cowpea	Table purpose potato	Okra
Conventional inorganic system	25 N-50 P_2O_5-25 K_2O kg/ha; Band placement	180 N-80 P_2O_5-100 K_2O kg/ha; Band placement and broadcasting	90 N-50 P_2O_5-75 K_2O kg/ha; Band placement and broadcasting
Integrated organic system	Okra stover: Approx. 7-14 t/ha; *in situ* incorporation + *Rhizobium, Bacillus subtilis, Trichoderma*; seed treatment & mixed with FYM+ FYM (2 t/ha)+ vermi-compost (1 t/ha); FYM before sowing, vermi-compost at sowing	Cowpea stover: Approx. 10-16 t/ha; *in situ* incorporation+ *Azotobacter, Bacillus subtilis, Trichoderma*; seed treatment & mixed with FYM+ FYM (12 t/ha)+ vermi-compost (6 t/ha); FYM before planting, vermi-compost at earthing	Potato haulms: Approx. 7-14 t/ha; *in situ* incorporation+ *Azotobacter, Bacillus subtilis, Trichoderma*; seed treatment & mixed with FYM+ FYM (6 t/ha)+ vermi-compost (3 t/ha); FYM & compost before sowing, vermi-compost at first picking
Organic system (Biofertiliser/ microbial formulation): *Rhizobium* (250g/ha seed treatment), *Bacillus subtilis* (250g/ha seed treatment), *Azotobacter* (250g/ha seed treatment), *Trichoderma* (4 kg/ha with 100 kg FYM for mixing in soil)			

productivity with sprinkler or drip irrigation as water is precisely applied in root zone and nutrient losses are minimum. In this case, irrigation is done at 15-25 mm Cumulative Pan Evaporation (CPE). Generally, drip irrigation is done on alternate days at 100-125% of CPE for 30-45 minutes and sprinkler irrigation is done twice in a week at 125-150% of CPE for 90-120 minutes in potato crop. Potatoes are grown mainly as a rain-fed crop in hills, but if the water is available and dry spell prolongs during crop period then light irrigation may be scheduled immediately after planting, during vegetative and tuberization phase. Micro-irrigation along with mulching can improve tuber and system productivity in hills under organic cultivation.

Weed management: Cultural and mechanical methods are adopted for weed control i.e. proper seedbed preparation having good soil moisture, planting of well-sprouted seed tubers at the optimum date, proper plant density, companion cropping, mulching, crop rotation and nutrient application in the root zone. First 20-40 days in plains and 50-60 days in hills are critical for weed control. In plains, inter-cultivation is done at 20- 25 days after planting when plant height is about 10-15 cm. This practice is followed by weed removal, application of the organic product for nitrogen and earthing up. In hills, two inter-cultural operations are advised. The first hand-weeding is done at 35- 40 days after

planting, while the second is performed at 55- 60 days. Like plains, weeds are removed, organic product is broadcasted in furrows and earthing is done. This practice improves root zone aeration, soil moisture conservation, better utilization of organic products and avoids greening of tubers.

Hot weather cultivation: This is a very economical and environment-friendly practice for keeping pests, diseases and weeds below a threshold level. In plains, the advantage of hot and dry summer season is utilized in a cropping system for withering all these hazards. Two-three deep field cultivations in this period are very useful for controlling annual and perennial weeds. Soil solarisation may be quite useful in specific situations or for premium potato crop like seed etc. This is done using transparent polyethylene (LLDPE) sheet of 25 to 100 mm thickness for 30 and 40 days during high-temperature period after giving light irrigation to the field (48 hours before this practice). These practice in hills may also be adopted particularly in lower altitudes and valleys.

Diseases management: Potato crop is affected by various diseases, which are caused by fungi, bacteria, virus and nematodes. Major diseases are early blight, late blight, leaf spot complex, black scurf, common scab, bacterial wilt, soft rot, charcoal rot, potato virus X, S, M, V, Y, stem necrosis, apical leaf curl virus and root-knot nematode etc. Integration of cultural and biological methods is permitted in organic cultivation. As chemical control is prohibited, so, suitable integrated disease management may be adopted for controlling one or more potent diseases of the region. Growing resistant cultivars and using disease-free seed is a very important component for all diseases management strategies. Green manuring and summer ploughing is also effective in checking such diseases. Tuber damage and injury must be avoided during harvest and post-harvest handling of tubers. Damaged and rotten tubers must be removed from the heap before storage. Late blight is controlled by adjusting planting dates to avoid its serious attack and making heavy ridges to reduce tuber infection. Field scouting is done to identify and destroy patches of primary infection by removal of infected plants after drenching them with permitted products. Irrigation should be stopped for some time when the weather condition is very congenial. *Trichoderma* viride @ 0.7% in liquid formulation and *Bacillus subtilis* @ 0.25% can be used for its control. Spraying should be initiated before the appearance of disease and number of sprays may be more depending upon disease severity. Use of copper oxychloride @ 0.2% and copper hydroxide @ 0.2 % have shown lower disease severity, so these can be used for late blight control with permission from the certification body. Avoid cultivation of other solanaceous crops and apply the recommended dose of organic manures/ products for sufficient nitrogen supply for controlling leaf spot complexes. Seed tuber treatment before storage with 3% boric acid for 25-30 minutes followed by drying under the shade, and crop rotation takes care of most of the seed/ soil-borne diseases like black scurf, fusarium wilt, dry rot, charcoal rot,

bacterial wilt and common scab. Soil solarization and bio-fumigation with cruciferous plant species (mustard, radish) is also very effective in controlling such diseases. Diseases like charcoal rot and soft rot require potato harvesting before the soil temperatures exceed 28°C. Planting of trap crop viz., marigold in alternate rows can reduce damage from the root-knot nematode. Viral diseases are kept in check by field sanitation, regular rouging and controlling weeds in seed crop.

Pest management: Control of aphids and whiteflies have been given in the section on potato seed. Other major pests are leafhoppers and mite, white grubs, thrips, cutworm, caterpillars and potato tuber moth. Avoid planting of potato crop, if temperatures are high, to control leafhoppers and mite. Summer ploughing and tillage before planting expose larvae of white grubs etc. to predators. Use of liquid culture of EPN (*Heterorhabditis indica*) prepared in water and EPN cultured in *Galleria* cocoons reduce white grub larvae in the soil. Dried *neem* leaves are used as mulch in organic plots to reduce the insect population by their decomposition and repellent action. Light and frequent irrigation will keep the thrips population in check. Caterpillars can be controlled by using light traps. Potato tuber moth is controlled by heavy ridging, use of water traps and covering of potato heaps with dried lantana and eucalyptus leaves.

Harvesting: Harvesting is done at the right maturity of a variety. Stop irrigation 8-10 days before haulm cutting for having proper soil moisture, avoiding the formation of soil clods and proper skin setting. Haulms are removed from field and digging is started 10-15 days after haulm cutting. Manual harvesting is done by using hand tools like spade and *khurpa*. The animal-drawn plough is another option and harvesting is carried out in big fields by tractor operated diggers. Tubers should be kept in heaps of 1.5-meter height covered with a thick layer of crop residues and left for skin maturity for another 10-15 days. Grading, marketing and storage are done after this process.

Certification of organic produce: Accredited certification bodies in case of NPOP and Regional Councils in case of Participatory Guarantee System (PGS) are responsible for certifying the organic food products. Certification of organic food is essential to ensure that they comply all the laid out standards. Organic foods should also comply for metallic contaminants, aflatoxins, naturally occurring toxic substances (NOTS), as specified under the Food Safety and Standards (Contaminants, Toxins and Residues) Regulation, 2011. In the case of residues of insecticides, the limit of residue shall be 5% of the maximum limits prescribed under the above mentioned regulations or Level of quantification (LoQ) whichever is higher. Organic foods should comply with other standards besides food safety parameters. Detail information can be sought from useful links given below.

Jaivik bharat: www.jaivikbharat.fssai.gov.in

National Program for Organic Production: **www.apeda.gov.in/ apedawebsite/**

organic/organic_ contents/national_programme_ for_organic_production.htm

Products for use in plant nutrition and soil conditioning (Source: NPOP)

Matter Produced on an Organic Farm Unit	
Farmyard & poultry manure, slurry, urine, crop residues and green manure, straw and other mulches	Permitted
Matter Produced Outside the Organic Farm Unit	
Compost from plant residue; Peat without synthetic additives (prohibited for soil conditioning); Sawdust, wood shavings, provided, it comes from untreated wood	Permitted
Blood, meat, bone and feather meal without preservatives; Compost made from any carbon-based residues (animal excrement including poultry); Farmyard manure, slurry, urine; Fish and fish products without preservatives; Guano; By-products from food and textile industries of biodegradable material of microbial, plant or animal origin without any synthetic additives; Seaweed and seaweed products obtained by physical processes, extraction with water or aqueous acid and/or alkaline solution; Sewage sludge and urban composts from separated sources monitored for contamination; Straw; Vermicasts; Animal charcoal;	Restricted
Compost and spent mushroom and vermiculate substances; Compost from organic household reference; By-products from oil palm, coconut and cocoa (including empty fruit bunch, palm oil mill effluent (pome), cocoa peat and empty cocoa pods); By-products of industries processing ingredients from organic agriculture	Restricted
Human excrement	Not allowed
Minerals	
Calcified seaweed; Calcium chloride; Calcium carbonate of network origin (chalk, limestone, gypsum and phosphate chalk); Sodium chloride; Magnesium sulphate (Epson salt); Gypsum (calcium sulphate); Clay (bentonite, perlite, zeolite)	Permitted
Basic slag; Calcareous and magnesium rock; Mineral potassium with low chlorine content (e.g. sulphate of potash, kaolinite, sylvinite, patenkali); Natural phosphate (e.g. rock phosphate); Pulverised rock; Trace elements (boron, Fe, Mn, Mo, Zn); Wood ash from untreated wood; Potassium sulphate; Aluminum calcium phosphate; Sulphur; Stone mill	Restricted
Microbial Preparations	
Bacterial preparations (bio-fertilizers), biodynamic preparations, plant preparations, botanical extracts, vermiculite, peat	Permitted

"Restricted: Conditions and procedure for use shall be set by the certification programme"

Products for plant pest and disease control (Source: NPOP)

Substances from plant and animal origin	
Plant-based extracts (*neem*, garlic, Pongamia etc.); Gelatine; Casein; Extract from mushroom (Shiitake fungus); Extract from *Chlorella*	Permitted
Azadirachta indica (*neem* oil etc.); Preparation of rotenone from *Derris elliptica, Lonchocarpus, Thephrosia* spp.; Propolis; Preparation of pyrethrins extracted from *Chrysanthemum cinerariaefolium*, containing possibly a synergist, Pyrethrum cinerafolium; Preparation from *Quassia amara*; Release of parasite predators of insect pests; Preparation from *Ryania* species; Lecithin; Seaweeds, seaweed meal, seaweed extracts, sea salt and salty water; Fermented product from *Aspergillus*; Natural acids (vinegar)	Restricted
Tobacco/ tea	Not allowed
Minerals	
Clay (bentonite, perlite, vermiculite, zeolite etc.); Sodium bicarbonate	Permitted
Chloride of lime/soda; Copper salts/inorganic salts (Bordeaux mix, copper hydroxide, copper oxychloride) used as a fungicide, maximum 8 kg/ ha/ year depending upon crop and under the supervision of inspection/ certification agency; Diatomaceous earth; Light mineral oils; Permanganate of potash; Lime sulphur (calcium polysulphide); Silicates (sodium silicate, quartz); Sulphur (as a fungicide, acaricide, repellent)	Restricted
Mineral powders (stone meal, silicates)	Not allowed
Microorganisms / Bio-control agents	
Viral preparations (Granulosis viruses, Nuclear polyhydrosis viruses etc.); Fungal preparations (*Trichoderma* species etc.); Bacterial preparations (*Bacillus* species etc.); Parasites, predators and sterilized insects	Restricted
Others	
Softsoap (potassium soap); Homeopathic and ayurvedic preparations; Herbal and biodynamic preparations	Permitted
Carbon dioxide and nitrogen gas	Restricted
Ethyl alcohol	Not allowed
Traps	
Physical methods (chromatic traps, mechanical traps, light traps, sticky traps and pheromones); Mulches, nets etc.	Permitted

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