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Organic Potato Production Technology For North Indian Plains

ICAR - Central Potato Research Institute
Shimla - 171 001 Himachal Pradesh, India

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ORGANIC POTATO PRODUCTION TECHNOLOGY FOR NORTH INDIAN PLAINS

Authors

Sanjay Rawal

SK Luthra

Kamlesh Malik

Mehi Lal

Pooja Mankar

VK Dua

SK Chakrabarti

ICAR – Central Potato Research Institute

Shimla - 171 001 Himachal Pradesh, India

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Dinesh Singh

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Dr SK Chakrabarti

Director

ICAR-Central Potato Research Institute, Shimla-171001 (HP)

Fax: 0177-2624460, Phone: 0177-2625073

Email: directorcpri@gmail.com, director.cpri@icar.gov.in

Website: http://cpri.icar.gov.in

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Contents

Abbreviations

APEDA	Agricultural and Processed Product, Export Development Authority
CPRI	Central Potato Research Institute
CPRI-RS	Central Potato Research Institute Research Station
DAC	Department of Agriculture and Cooperation
GMO	Genetically Modified Organisms
ICAR	Indian Council of Agricultural Research
IFOAM	International Federation of Organic Agriculture Movement
LoQ	Level of Quantification
MRL	Maximum Residual Limit
mt	Million tonne
NAB	National Accreditation Body
NAC	National Advisory Committee
NCOF	National Centre of Organic Farming
NGO	Non-Government Organization
NPOP	National Programme for Organic Production
NSOP	National Standards for Organic Production
PGS-India	Participatory Guarantee System of India

FOREWORD

Organic farming is emerging as a potential mean to produce quality food by maintaining ecological balance. In the recent past, it has gained considerable attention and has emerged as a dynamic 'Alternate Farming System'. It is becoming popular in domestic as well as international market as the consumer is becoming more serious about the quality of food especially about chemical residues. This awareness and demand for quality food have created new market opportunities for farmers. Farmers can fetch premium prices from such produce and potato is no exception to all these trends and market avenues. During and after the green revolution, high yielding varieties were used to produce food for a rapidly growing population, which demanded higher doses of fertilizers. This in-turn, resulted in more pressure of diseases and pests and thus higher use of agro-chemicals. Thus un-judicious use of synthetic products started deterioration of precious natural resources like soil, water and air. In turn, food and nutritional quality of produce started deteriorating. Consumption of such food started disturbing the health of humans and livestock in several ways.

The principal objective of organic production system is quality food production for human and animals while maintaining ecological and economic viability. Safety, protection and conservation of environment are the need of hour and organic cultivation practices ensure this. Government of India is developing policies to ensure the genuineness of organic produce and farmers are showing enthusiasm to take up organic farming by following these policies. Like several other crops and farm enterprises, potato can also play a potential role in improving farm income by way of its organic production. Potato is a significant component of diet at national level as it is consumed fresh as well as in processed form in numerous ways. Globally, India is the second-largest producer of potatoas evident from its total production of 51.3 mt from 2.14 mha area with approximately 2.4 t/ha of average yield. While approximately 87% contribution comes from North Indian plains. Current scenario of this crop in India suggests its diversified

production and utilization in the domestic and export market. Higher profits can be earned in domestic as well as international market by way of organic potato production.

I am indeed happy and feel satisfied that the Institute has developed production technology of potato crop for this purpose for the plain region which would help potato growers in coming time. This bulletin will address the queries of farmers about organic methods of potato cultivation. This document would ultimately help them in protecting their farm resources and in improving their income. I expect that future is also bright for organic potato cultivation as refinement would go on in different components of production technology to bring at par productivity in the organic potato production system as compared with inorganic potato production techniques.

Director

ICAR-CPRI, Shimla

INTRODUCTION

The movement of organic farming is gaining momentum steadily worldwide due to several conclusive ill effects of chemical farming. Unpredictable changes in global climate have also put pressure on the agricultural sector for adopting technologies to mitigate the impact of climate change. Therefore, ways and means have to be found out to reduce carbon footprint and this can be made possible by minimum or negligible use of synthetic products and complete recycling of farm resources. Organic farming gives a ray of hope, so, all components of production technology of a system are needed to be developed for any sustainable organic farming system. Development of varieties, rapid availability of nutrients through natural means, organic products for weed control and crop protection would play a very significant role in this direction.

Potato crop cannot remain untouched with recent developments of alternative farming as it constitutes the main ingredient of the Indian diet. People not only prefer fresh potatoes but also likes its processed products like region-specific dishes, chips, french fries and flakes etc. India is the second-largest producer of potatoes in the world and major chunk of this is coming from north Indian plains. Sufficient scope exists in this region of increasing diversified utilization of this crop and organic potatoes can be one of that. States of Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal and Assam have the huge potential of organic potato cultivation. Work on this aspect was going on in the past one decade in the Institute and production technology is now available to have yield level better than the national average.

NSOP BASED PRE-REQUISITES FOR ORGANIC FARMING

Potato crop production plan

Potato is an annual crop and its organic crop production management should cover diverse planting schemes like crop rotation practices, cover crops, green manures, intercropping or other diverse plant production methods. The farmers or group of farmers interested to take up organic potato cultivation should develop an organic crop production plan. This should include points, which are mainly, recording a complete description of all crops (main crop, intercrop, sequential crop etc.) cultivated during the production cycle. Description of all agronomic practices and procedures carried out should be maintained. Complete information of all inputs used in farms like their source, elemental composition, usage frequency, rate of application, time of application, mode and method of application, storage etc. should be available in farm records. Inputs used for organic farming should be organic whether it is seed or seedlings or any other input. Record of all practices and procedures performed on the farm should be maintained in order to ensure the accuracy and efficiency of the plan. Established management practices and physical barriers should be adhered to prevent mixing and contamination of organic production unit from non-organic farms. It can be concluded that maintenance of record for all farm operations is must in order to comply with the organic standards and certification process.

Organic farm conversion requirement

A conversion period is an interim period required to establish an organic management system and soil fertility built-up. The start of the conversation period can be counted from the day of first inspection by the certification agency. Conversion period may or may not be sufficient in order to develop the organic management system and build-up of soil fertility, however, it is the period during which all necessary actions required to achieve the goal are to be initiated. A clear plan is to be prepared about how to convert a farm into an organic one. This should be updated by the farmer/s to comply with all standards. Requirements mentioned in the standards shall comply

in this conversation period. All these requirements shall be applicable from the commencement of conversion period until its conclusion. At locations where *de facto* requirements prescribed under these standards have been met for several years, a full conversion period is not required and based on available documentation, the same can be verified. Under such scenario, inspections shall be carried out at a reasonable time interval prior to the first harvest.

Duration of conversion period

In case of potato, which is an annual crop, the tubers produced can be certified organic when the requirements prescribed under standards have been met during the conversion period of at least two years under organic management before the start of production cycle. The accredited certification bodies shall decide in certain cases for extension or reduction of conversion period depending on the past status/use of land and environmental condition. Twelve months reduction in conversion period could be considered for annuals as well as perennials provided documentary proof has been made available to certification body that the requirements prescribed under these standards have been met for a period of minimum three years or more. This could include the land that has been certified for a minimum three years under PGS-India, and wherein, the products approved for use in organic farming as listed in Annexure I and II have been applied. Certification bodies shall also consider such a reduction in conversion period, if it has satisfactory proof to demonstrate that for three years or more, the land has been idle and/or it has been treated with the products approved for use in organic farming as listed in Annexure I and II. Organic produce of farm shall be sold as "produce of organic agriculture in conversion" or of a similar description during the conversion period when the requirements prescribed under these standards have been met for at least twelve months.

Landscape

Organic farming is determined for biodiversity maintenance and natural conservation. The organic farming certification program shall set standards or procedures for a small farm area to facilitate biodiversity and natural conservation. Areas which are managed organically shall facilitate biodiversity. These may be extensive grasslands such as moorlands, reed land or dry land; all areas which are not under rotation and are not heavily manured; extensive pastures, meadows, extensive grassland, extensive orchards, hedges, hedgerows, groups of trees and/

or bushes and forest lines; ecologically rich fallow land or arable land; ecologically diversified extensive field margins; waterways, pools, springs, ditches, wetlands and swamps and other water-rich areas which are not used for intensive agriculture or aqua production.

Diversity in crop production and management plan

The basis for crop production in organic farming shall take into consideration the structure and fertility of soil and the surrounding ecosystem in order to minimize nutrient losses. Where appropriate, organic farms shall be required to maintain sufficient diversity in a manner that takes into account pressure from insects, weeds, diseases and other pests, while maintaining or increasing soil organic matter, fertility, microbial activity and general soil health. Soil fertility shall be maintained through the cultivation of legumes or deep-rooted plants and use of green manures, along with the establishment of a programme of crop rotation and nutrient application with organic inputs.

Contamination control

All relevant measures should be followed to minimize the contamination from outside and within the farm. Buffer zones shall be maintained to prevent contamination from conventional or non-organic farms. The buffer zone should be sufficient in size to prevent the possibility of unintended contact of prohibited substances applied to adjacent conventional land or farms. In case of doubt about contamination, analyze the relevant products and sources like inputs, soil and water etc. under a certification programme to measure the contamination level. Polyethene and polypropylene or other polycarbonates coverings such as plastic mulches, fleeces, insect net and silage wrapping are allowed. These shall be removed from the soil after use and shall not be burnt on the farmland. The use of polychloride based products is prohibited.

Soil and water conservation

Soil and water resources shall be handled in a sustainable manner. Relevant measures shall be taken to prevent erosion, salinization of soil, excessive and improper use of water and the pollution of ground and surface water. Clearing of land through the means of burning organic matter, e.g. slash-and-burn, straw burning shall be restricted to the minimum. Clearing of primary forest is prohibited. Certification programme shall require checking appropriate stocking rates which do not lead to land degradation and pollution of ground or surface water.

ORGANIC POTATO PRODUCTION TECHNOLOGY

A brief description of the package of practice for organic cultivation of potato in North Indian plains is described in this chapter. Organic potato production technology includes suitable variety, seed and its preparation, seedbed 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.

Choice of variety

As per NSOP norms, species and varieties cultivated under 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 organic farming. In case of potato, trials conducted at CPRI-RS, Modipuram had shown that recently released varieties like Kufri Mohan, Kufri Khyati, Kufri Garima, Kufri Sadabahar, and earlier varieties like Kufri Pushkar and Kufri Anand are promising varieties for organic cultivation due to their better marketable yield potential under organic cultivation (Table 1). Kufri Himsona and Kufri Chipsona-3 are better varieties for process grade tuber yield.

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, medium-deep eyes, cream flesh
Kufri Sadabahar	26.0	27.0	90-100	Late blight	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

Potato Seed

NSOP norms state that all seed/ planting material should be a certified organic one. If such material is not available then use chemically untreated conventional seed/ planting material. 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 prohibited 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 of 20 per 100 compound leaves.Monitoring of aphids is done by placing a yellow water trap.Yellow coloured sticky traps are placed 8-10 days after planting to trap 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 repellant action. Combination of *neem* leaves with weekly foliar sprays of horticulture mineral oil @ 0.5% resulted in the reduction of whiteflies and aphids. Potato is attacked by several leaf-cutting caterpillars during December- January. ICAR-VPKAS, Almora and National Center for Integrated Pest Management (NCIPM), New Delhi have designed light traps which are used to capture moths at night.

Organic potato production of variety Kufri Mohan

Seed preparation

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

Seedbed preparation

Sub-soiling in the initial phase of organic farming is the best method for loosening the soil. It should be performed during May- June for breaking hard pan just below the plough layer. Later on higher soil, organic carbon and fauna activity keep soil sufficiently aerated and loose for better root development. It is recommended to have pre-planting irrigation at 7-10 days before field preparation if sufficient soil moisture is not available. 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.

Planting time and spacing

Optimum planting time is when maximum day temperature is below 32°C and low night temperatures (< 20°C) occur during tuberization which is about 25-30 days after planting. Better growth, tuber initiation and bulking take place during 15-25°C. Planting time is adjusted for better tuber initiation and development which coincides with these temperatures. Row-to-row and plant-to-plant spacing should be kept at 67.5 cm and 20-35 cm. Plant to plant spacing varies with seed size. Medium seed size tubers (35-45 mm) are planted at 20 cm spacing. Planting depth should be kept at 8-10 cm. Bed planting (two/ three-row; base 132 cm) should be followed in micro-irrigation.

Mulching

Use of crop residue in organic farming of potato

Mulching is a very efficient traditional way of controlling weeds, conserving soil moisture and slow decomposition of organic residues in soil. It is a very proficient way for smothering weed growth during crop season and more specifically for annuals. The main objective of mulching is to deprive weeds of solar radiation and thus inhibition of crop growth. Germination of weeds is also hampered and this practice helps in conserving soil moisture, which facilitates quick emergence of potato plants. Crop residue, dry straw, dry grasses, pine needles and other vegetative material may be utilized in this operation. Plastic mulching has also come up as a promising technique for weed control in combination with micro-irrigation.

Nutrient management

As per NSOP norms, only on-farm produced microbial, plant or animal origin biodegradable material should be used as a source of nutrient management. There is a limit for using outside farm produced microbial, plant or animal origin biodegradable material. Non-synthetic mineral fertilizers and brought-in biological origin fertilizers should be regarded as the supplementary source and not as a replacement for nutrient recycling. The objective of nutrient management is to avoid nutrient losses, accumulation of heavy metals and other pollutants. Mineral fertilizers should only be used in a supplementary role to carbon-based materials. Only permitted organic or mineral fertilizers should be used and they should be used on-farm only when other fertility management practices have been optimized. Manures containing human excreta are prohibited to prevent transmission of pests, parasites and infectious agents. Mineral fertilizers shall be applied in their natural composition and shall not be rendered more soluble by chemical treatment. Certification may grant exceptions but these exceptions shall not include mineral fertilizers containing nitrogen. Restrictions are there for the use of inputs such as mineral potassium, magnesium fertilizers, trace elements, manures and fertilizers with a relatively high heavy metal content and/or other unwanted substances, e.g. basic slag, rock phosphate and sewage sludge. 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 (Annexure I). Examples of nutrient budgeting have been mentioned inTable 2 and 3.

Crop rotation

Preceding and succeeding crops should not be exhaustive like potato crop. Farmers can select potato varieties and adjust crop duration suitable to their overall farming situation. Similar is the case with other crops followed in cropping/ inter-cropping systems. At least one leguminous, vegetables or green manure crop should be included in potato based cropping systems. The continuous raising of potato crop should not be followed on the same field to avoid pest build-up and two to three-year rotation may be adopted. In Institute studies, crop rotation of maize- potato- onion, groundnut- potato- green gram, cowpea (vegetable)- potato- okra and groundnut- potato- maize+ green gram were found promising. Basmati rice- potato- late sown wheat also sustained productivity with an organic source of nutrition and *in situ* crop residue recycling.

Various crops used in crop rotation

Green manuring

Green manures improve potato tuber yield and soil productivity as they supply organic matter and additional nitrogen. Green manure crops like sunhemp or *dhaincha* should be adjusted in crop scheme. A

leguminous crop with 10-20 t of biomass per hectare adds about 60-100 kg/ha of nitrogen. Also, it also helps in reducing the incidence of soil-borne diseases like black scurf and common scab etc. 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 invariably indispensable part of organic farming. Several available methods can be used for this activity.

Table 2: 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. 15-19t/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. 5-10t/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 up	Potato haulms: Approx. 4-7t/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)			

Table 3: 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 up	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)			

Water management

Potato is a sensitive crop to water stress as stolon formation and tuber initiation stages are the most sensitive stages. In general, time interval approach is adopted in autumn season in ridge- furrow system where the plot of 8-10 furrows and 6-8 m in length are prepared and water is let into them till water level reaches half of the ridge height. Around 50 mm water is applied during each irrigation. Irrigation is scheduled at 8-10 days interval in initial period when temperatures are moderate and interval is increased to 12-15 days during the winter. Water application is stopped 10-12 days before haulm cutting for better skin setting. Irrigation on the basis of cumulative pan evaporation (CPE) is preferred in micro-irrigation. In this case, irrigation is done when CPE reaches 15-25 mm depending upon soil type and variety. Recommendations of research institutions at the regional level may be adopted. Generally, drip irrigation is done on alternate days at 100-125% CPE for 30-45 minutes and sprinkler irrigation is done twice in

a week at 125-150 CPE for 90-120 minutes in potato crop. Water losses are minimum under drip (4-5%) and sprinkler irrigation (15-20%) as compared to flood irrigation (40-50%). In experiments on organic farming, it was observed that system productivity of more than ninety per cent could be achieved with a sprinkler or drip irrigation where water was precisely provided in root zone and nutrient losses were also minimized. Adoption of a micro-irrigation system can give a boost to potato and system productivity under organic cultivation.

Inter-cultural operations

Inter-cultural operations are done at 20-25 days when potato plants have 10-15 cm height for reducing soil compaction, better root aeration and weed control. Soil cover at planting is not sufficient as irrigation erodes the ridges, particularly in light soils and exposure of stolon to light, may make it an aerial stem. Tubers in ridges also become prone to greening which is not fit for marketing. Inter-cultivation is done in the morning, the field is exposed to sunlight for the whole day and weeds are removed manually. Ridging is followed next day after application of the remaining dose of nitrogen through vermicompost or other organic product. Hand tools like *Khurpa* and spades are used in small fields. Bullocks drawn inter-cultivator and mouldboard plough can also be used in small fields. In mechanical cultivation, tractor-drawn 2-4 row cultivator and ridgerare used for this operation.

NPOP norms for weeds, diseases and pests management

NPOP norms should be considered seriously for control of pest, diseases and weeds. To ensure minimum losses from these under organic cultivation, emphasis should be on balanced nutrition, suitable variety, fertile soils with high biological activity, crop rotations, green manuring, intercropping, mulching, land preparations etc. Natural enemies of pests and diseases should be protected and encouraged through proper habitat management of hedges, nesting sites etc. An ecological equilibrium should be created to bring about a balance in pest- predator cycle. Products prepared at farm level from local plants, animals and microorganisms are permitted for pests, diseases and weed control. Thermic weed control and physical methods are also 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. Permission from certification agency is required

on case to case basis. All equipment from conventional farming systems should be properly cleaned and free from residues before being used in the organic field. Use of synthetic herbicides, fungicides, growth regulators, synthetic dyes insecticides and other pesticides are prohibited. Permitted products for weed, pest and disease control are listed in Annexure-II. Use of genetically engineered organisms or products is prohibited.

Weed management

Crop-weed competition is managed by optimum planting date and plant population, companion cropping, crop rotations and fertility manipulation. Weeds are suppressed out specifically in initial phases of crop growth by way of crop competition through the adoption of best crop production practices and making major components of crop growth in favour of the potato crop. It includes vigorous and faster growth of potato plants and having crop environment such that it always smothers weeds. Weeds emerging out under better crop canopy are generally frail and will not be much harmful to tuber productivity. First 20-40 days are critical for weed control in plains. Potato cultivars having vigorous and rapid growing habits may prove better competitors for weeds as they cover fields quickly and overwhelm these undesirable plants. Crop rotation may be done following at least two-year crop rotation in a particular field or having green manure crops like *dhaincha*, cowpea etc. for smothering weeds. Two- three year crop rotation will assist in reducing weed seed bank in field, while green manuring (45-50 days) shall reduce their intensity as they get buried along with the green manure crops and are decomposed. Seedbed should be prepared thoroughly depending upon soil type of a region. Pre-plant tillage operations for making a proper soil tilth not only accelerate faster emergence of potato plant but also destroy weeds and give an edge to the crop. Seedbed should contain sufficient soil moisture and if moisture is low than pre-planting irrigation is advised before cultivation. A competitive edge is given to potato crop by way of optimized planting time. First of all, a variety should be planted at an optimum date and well-sprouted seed tubers should to be used at optimum crop geometry and planting depth. At planting, nutrient inputs should be precisely placed in bands 5-6 cm below seed tubers, so that these inputs remain in the root zone of the crop for efficient nutrient utilisation. Inter-cultivation is done 20- 25 days after planting when plants attain 10-15 cm height. Later on, crop canopy shall cover the field and weeds do not dominate.

Hot weather cultivation

This can be economic and environmental friendly tool for pests, disease and weed management. Advantage of hot and dry summer season should be harnessed in a cropping system for desiccating all these menaces. Two-three deep field cultivations in this period are very useful for the control of annuals and also for perennials like *Cynodon dactylon* L. Similarly, soil solarisation may be quite useful in specific situations or for premium potato crop like seed etc. Soil solarization is done using transparent polyethylene (TPE) sheet of 0.05 and 0.10 mm thickness for 30 and 40 days during high-temperature period after giving light irrigation to the field (48 hours before this practice).

Diseases management

The 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 disease of the region. Growing resistant cultivars and using disease-free seed is a very important component for all diseases. Green manuring and summer ploughing during summer 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 restricted 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 subtillus* @ 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 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. Trap crop like marigold in alternate rows can reduce root-knot nematodes. 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 section : potato seed. Other major pests are leafhoppers, mite, white grubs, thrips, cutworm, caterpillars and potato tuber moth. Avoid planting of the 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 repellant 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

Harvest potato tubers at right maturity when the skin is properly set. Stop irrigation 8-10 days before haulm cutting so that soil has enough moisture at the time of harvest and there is no formation of soil clods. Remove haulms when the crop is fully mature and start digging only after 10-15 days, so that tuber skin is fully mature at the time of harvest and heap making. For manual harvesting, use hand tools like spade and *khurpa* to dugout the tubers. Animal-drawn plough is another option, which is faster as compared to the manual method. Harvesting is delayed and fields become dry in case of bigger farms. So, tractor operated diggers, multipurpose diggers are fast, economical and cause least damage to the tubers and popular for harvesting of potatoes.

CERTIFICATION OF ORGANIC PRODUCE

The accredited certification bodies in case of NPOP and Regional Councils in case of PGS-India are responsible for certifying the organic food products (Annexure-IV). Certification of organic food is essential to ensure that they comply all the laid out standards. Organic foods should also comply with the requirements for metallic contaminants, aflatoxins, naturally occurring toxic substances (NOTS) and pathogens as specified under the Food Safety and Standards (Contaminants, Toxins and Residues) Regulation, 2011. In 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. The organic foods should comply with other standards besides food safety parameters. The organic foods should comply with the requirements of various parameters covered under the Food Safety and Standards (Food Product Standards and Food Additives) Regulations, 2011. Detail information can be sought from useful links given in the last of this article.

Brief description of terms and process used in organic farming (Adopted from APEDA)

Accreditation-Accreditation means a procedure adopted by the National Accreditation Body for ascertaining the competence of a Certification Body to certify organic farms, products and processes as per the National Standards for Organic Products.

Accreditation body- Accreditation Body shall be the agency set up by the Steering Committee for National Programme for Organic Production for accrediting Certification Body.

Accredited certification body- An organization with legal entity complying with NPOP accreditation criteria and recognized by the National Accreditation Body for certifying organic products and for granting the right to use Certification Trade Mark to the operators on behalf of Accreditation Body.

Accredited programme- It is the programme of Certification Body that has been approved by the Accreditation Body on the basis that it is in compliance with the provisions of National Programme for Organic Production.

Buffer zone- A clear defined and identifiable area boarding an organic production /site from that of the conventional production unit.

Certificate of accreditation- This is a document issued by APEDA, on behalf of National Accreditation Body (NAB) to the Certification Body certifying that accredited Certification Body is compliant with the standards as envisaged under National Programme for Organic Production and is competent to certify producers as per the standards specified by National Standards for Organic Production.

Certification- Certification shall refer to the procedure by which the accredited Certification Body by way of a Scope Certificate assures that the production or processing system of the operator has been methodically assessed and conforms to the specified requirements as envisaged in the National Programme for Organic Production.

Certification Trade mark- shall mean the India Organic Logo, which is owned by the Ministry of Commerce.

Certification programme- It shall mean that the system operated by a Certification Body in accordance with the criteria for carrying out certification of conformity as laid down herein.

Compliance- Compliance shall mean the adherence to the norms laid down under NPOP.

Consultancy- Consultancy shall mean the advisory service for organic operations, independent from inspection and certification procedures.

Conventional farming- Conventional farming shall mean the farming systems dependent on the input of artificial fertilizers and/or chemicals and pesticides or which are not in conformity with the basic standards of organic production.

Conversion- Conversion is the process of changing an agricultural farm from conventional to the organic farm. This is also called a transition.

Conversion period- This is the time between the start of organic management and the certification of crops as organic.

Inspection- It shall include the site visit to verify that performance of an operation

is in accordance with the production, processing and chain of custody as per NPOP standards.

ISO guide 65/ ISO 17065- These are general requirements for Certification Bodies operating product certification system.

ISO 17011- These are general requirements for accreditation bodies carrying out accreditation of Certification Bodies.

Labelling- Labeling shall mean any written, printed or graphic representation that is depicted on the label of the certified organic product, for the purpose of promoting its sale.

License- It is the permission granted to the operator by the accredited Certification Body on behalf of National Accreditation Body to use the Certification Trade Mark "India Organic Logo" to certify that their products or processes are organic.

National programme for organic production (NPOP)- NPOP has set up standards for organic production, criteria, system, and accreditation procedure from certification bodies, "India organic logo" and regulations governing it.

National standards for organic production (NSOP)- NSOP sets out the standards to be followed in cultivation/ harvest/ production /processing and trading of organic products

Organic- Organic refers to a particular farming system as described in the standards.

Organic agriculture- It is a system of farm design and management to create an eco-system, which can achieve sustainable productivity without the use of artificial external inputs such as chemicals, fertilizers and pesticides.

Package of practices- The guidelines for organic production and processing for specific crop and region.

Parallel production- Parallel production shall mean any production where the same unit is growing, breeding, handling or processing the same products both in a certified organic quality and a noncertified organic quality. Similarly, a situation with "organic" and "in conversion" production of the same product is also parallel production.

Plant protection product- Plant protection product shall mean any substance intended for preventing, destroying, attracting, repelling, or controlling any pest or disease including unwanted species of plants or animals during the production, storage, transport, distribution and processing of food, agricultural commodities, or animal feeds.

Participatory guarantee system of India-PGS-India is a decentralized organic farming certification system under Department of Agriculture & Cooperation, Ministry of Agriculture and Farmers Welfare, Government of India. It is a quality assurance initiative that is locally relevant, emphasize the participation of stakeholders, including producers and consumers and operate outside the framework of third party certification.

Standards- Standards shall mean the NSOP approved by the National Steering Committee for NPOP.

TraceNet- TraceNet is an internet-based electronic service offered by APEDA to the stakeholders for facilitating process certification for the export of organic products from India which comply with the NPOP or NSOP standards. TraceNet collects stores and reports- forward and backward traces and quality assurance data entered by the operators/ producer groups and certification bodies within the organic supply chain in India.

ANNEXURES

Annexure I

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, wood provided it comes permitted 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; 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, kailinite, sylvinite, patenkali); Natural phospahte (e.g. rock phospahte); 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, vermiculate, peat	Permitted

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

Annexure II

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	Permitted
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

Average nutrient content in various manures

Table 1: Average nutrient content of bulky organic and green manures

Manure	Percentage content (dry weight)		
	Nitrogen	Phosphoric acid (P_2O_5)	Potash (K_2O)
Farmyard manure	0.95	0.62	2.20
Rural compost	0.75	0.63	1.05
Urban compost	1.35	0.62	1.45
Sesbania	2.01	0.32	2.03
Sunhemp	2.16	0.48	2.11
Cluster bean	1.46	0.25	1.89
Cowpea	2.45	0.56	2.32

Table 2: Average nutrient content of major concentrated organic manures

Manure	Percentage content (dry weight)		
	Nitrogen	Phosphoric acid (P_2O_5)	Potash (K_2O)
Castor	4.3	1.8	1.3
Cottonseed cake un-decorticated	3.9	1.8	1.6
Neem cake	5.2	1.0	1.4
Safflower cake un-decorticated	4.9	1.4	1.2
Groundnut cake	7.3	1.5	1.3
Linseed cake	4.9	1.4	1.3
Niger cake	4.7	1.8	1.3

Table 3: Average nutrient content of crop residues

Manure	Percentage content (dry weight)		
	Nitrogen	Phosphoric acid (P_2O_5)	Potash (K_2O)
Rice straw	0.60	0.24	1.48
Wheat straw	0.56	0.11	1.52
Maize stalks	0.42	0.45	1.65
Potato haulms	1.90	0.36	2.14
Sunflower stalks	1.90	0.61	2.10
Vegetable peas straw	1.40	0.32	1.27
Banana dry	0.61	0.12	1.00

Table 4: Characteristics of vermicompost prepared from organic wastes

Substrate	C/N ratio	Available nutrient			Microbial counts
		Nitrogen	P_2O_5	K_2O	
Cow dung					
Original	49.16	0.53	0.003	0.104	-
Vermicomposted	16.83	1.20	0.004	0.396	24 x 106

Annexure IV

Accredited certification bodies under NPOP (Source: APEDA)

Name of certification agency and accreditation no.	Contact person and address
Bureau Veritas (India) Pvt. Limited NPOP/NAB/001	Mr. Ramesh Koregave Director – Certification: 72 Business Park, Ground Floor Marol Industrial Area, MIDC Cross Road 'C', Andheri (East) Mumbai - 400 093, Maharashtra Email : kaushik.sengupta@in.bureauveritas.com Contact Number : Office : +91 22 62742905; Mobile :+91 22 8691874332; Direct : +91 22 62742932 Website : http://www.bureauveritas.co.in
ECOCERT India Pvt. Ltd. NPOP/NAB/002	Mr Anil Jadhav Chief Executive Officer: Unit number 801, 8th Floor, The Palm Square, Sector 66, Golf Course Extension Road, Gurgaon 122102 Haryana India Telephone: +91-124-6999959 Fax: +91 124 4313171 Email: anil.jadhav@ecocert.com Website: www.ecocert.in
IMO Control Pvt. Ltd. NPOP/NAB/003	Mr Umesh Chandrasekhar Director: No. 3627, 1st Floor, 7th Cross, 13th 'G ' Main, H.A.L. 2nd Stage, Bangalore-560 008. Tel. No: +91-80-25285883, 25201546, 25215780 Fax: 0091-80-25272185 Email: imo@imocontrol.in , Web: www.imocontrol.in
Indian Organic Certification Agency (INDOCERT) NPOP/NAB/004	Mr Mathew Sebastian, Executive Director: Kuttamassery, Thottumugham P.O Aluva – 5, Ernakulam District Kerala, Telefax: 0484 2922400, 2630908 Email: info@indocert.org Web: www.indocert.org
Lacon Quality Certification Pvt. Ltd. NPOP/NAB/006	Mr Bobby Issac, Director, Chenathra, Theepany, Thiruvalla - 689 101 (Kerala) Tel. No: 0469 2606447 Fax: 0469 2631902 Email: info@laconindia.com , Web: www.laconindia.com
OneCert Asia Agri Certification (P) Ltd. NPOP/NAB/008	Mr. Sandeep Bhargava, Chief Executive Officer: H-08, Mansarovar Industrial Area, Mansarovar Jaipur-302020, Rajasthan , Phone & Fax- 0141-2395481,6541882, 6541883 Email:- info@onecertasia.in , Web site:- www.onecertasia.in
SGS India Pvt. Ltd. NPOP/NAB/009	Mr. Soumik Mondal National Certification Manager, SGS India Pvt Ltd 226,Udyog Vihar, Phase-I Gurgaon-122016 Haryana Tel: +91 124 6776300 Ext 6379 91 124 6776379 (Direct) Fax: +911246776403/04 Mobile: +91 8860117818 Email: Soumik.Mondal@sgs.com , Website www.sgsgroup.in
Control Union Certifications NPOP/NAB/0010	Dr. Binay Kumar Choudhury, Chairman, Plot No. C-113, Pawane MIDC, Navi Mumbai - 400709 Tel: +91-22-61294300 Fax:+91-22-61294217 Mobile: 9969002860 Email: cuc@controlunion.in, bkchoudhury@controlunion.com Website: www.controlunion.com

Uttarakhand State Organic Certification Agency (USOCA) NPOP/NAB/0011	Sh. Gauri Shankar, Director, Third Floor, Krishak Bhavan, Mussoorie By-Pass Ring Road Nehru Gram, Dehradun, Uttarakhand Tel: 0135 2671734 Email: info@usoca.org, Website: www.usoca.org
APOF Organic Certification Agency (AOCA) NPOP/NAB/0012	Mr Swapnil Satish, General Secretary, Holkar House, First Floor, Sr no: 54, Near Nikhil Garden, Wadgaon Bk. Pune 411041 Phone /fax: 020-65410070 Mobile: +91 7720073202 Email: info@aoca.in, Website: www.aoca.in
Rajasthan Organic Certification Agency (ROCA) NPOP/NAB/0013	Mr Madhu Sudan Sharma, Director, 3rd Floor, Pant Krishi Bhawan, Janpath, Jaipur 302 005 Rajasthan Tel. No.: 0141-2227104, Tele Fax: 0141-2227456 Email: rocajpr.cb@gmail.com, Website: www.mpsoca.org
Vedic Organic Certification Agency NPOP/NAB/0014	Dr. (Mrs.) M. Usha, Managing Director, Plot no-54,Ushodaya Enclave Mythrinagar, Miyapur Hyderabad-500050 Telangana Phone: 040-65276784 Fax: 040-23045338 Email : voca_org@yahoo.com , Website: www.vediccertification.com
ISCOP (Indian Society for Certification of Organic Products) NPOP/NAB/0015	Prof: Dr K. K. Krishnamurthi, President, Indian Society for Certification of Organic Products (ISCOP) 135, Ponnurangam Road West R.S. Puram, Coimbatore-641002 Tamil Nadu Phone:0422-2544199/ 0422-2546160 Mobile:91 94432 43119 Email: iscopcbe@gmail.com Website:iscoporgcertindia.com
TQ Cert Services Private Limited (formerly FoodCert India Private Limited) NPOP/NAB/0016	Mr Tenny Koshy Cherian, Director, A Wholly Owned Subsidiary of Tata Projects Limited 4th floor, Mithona Towers-I 1-7-80 to 87 Prenderghast Road, Secunderabad Telangana - 500003 Mob: +91 9848335693; 9654803362 Email: tq@tqcert.in; tennycherian@tataprojects.com, Website:- www.tqcert.in
Aditi Organic Certifications Pvt. Ltd NPOP/NAB/0017	Mr Narayana Upadhyaya, Director, Aditi Organic Certifications Pvt. Ltd. No. 38, 1st Floor, 20th Main Road, First Block, Rajajinagar, Bengaluru-560010 Tel.: +91-080 23328134/35/36 Fax: +91-80-23373083 Mobile: +91-9845064286 Email: aditiorganic@gmail.com, Website: www.aditicert.net
Chhattisgarh Certification Society, India (CGCERT) NPOP/NAB/0018	Mr S.C. Agrawal (IFS), Chief Executive Officer, Campus SFRTI Near Vidhan Sabha Zero point, Baloda Bazar Road, Raipur, Chhattisgarh 493 111 Tel: +91-771-2283249 Fax: +91-771-2283249, Email: cgcert@gmail.com, Website: www.cgcert.com
Tamil Nadu Organic Certification Department (TNOCD NPOP/NAB/0019	Mr N. Sundar, Director, 1424 A, Thadagam Road G.C.T Post, Coimbatore – 641013 Tamil Nadu Tel.: 0422 2435080 Fax: 0422 2457554 Email: tnocdcbe@gmail.com Website: www.tnocd.net
Intertek India Pvt. Ltd. NPOP/NAB/0020	Mr. Neeraj Gupta, (Head–Certification, Food Services), E-20, Block B-1 Mohan Cooperative Industrial Estate Mathura Road New Delhi - 110 044 Ph : +91-11-4159 5430/ +91 9971656236 Fax : +91-11-4159 5475, E-mail:neeraj.gupta@intertek.com, Websit : www.intertek.com

Madhya Pradesh State Organic Certification Agency NPOP/NAB/0022	Mr K.S. Tekam, Managing Director, Vasundhara, B-II Office Complex Gautam Nagar Bhopal 462 023 Madhya Pradesh Tel: 0755 2600609 E-mail: md.mpsoca@gmail.com, Website: www.mpsoca.org
Odisha State Organic Certification Agency (OSOCA) NPOP/NAB/0025	Mr Subash Chandra Biswal, CEO, Plot No.-326, Baramunda, Bhubaneswar, Odisha, 751003 Phone-(0674) 2563639/2561783 Fax.-(0674)2562078 Mobile No.- 9437211001 Email: ceoosoca@gmail.com, directorossca@rediffmail.com, Website: www.ossopca.org
Natural Organic Certification Agro Pvt. Ltd. NPOP/NAB/0026	Mr Sanjay Deshmukh, Managing Director, Office No.2 Karan Plaza-II Near Rosary School Warje Pune - 411058 Maharashtra State Tel- 91-20-65218063 Cell no. 09822006586 E mail-nocaindia@gmail.com, Web site: www.nocaagro.com
Fair Cert Certification Services Pvt. Ltd. NPOP/NAB/0027	Dr Pushkar Kulshrestha, CEO, C-122, Gauridham Colony Khargone Madhya Pradesh 451001 Tel: +91-7282-231271/203017 Fax: +91-7282-231271 E-mail: cert.fair@gmail.com, Website: www.faircert.com
Gujarat Organic Products Certification Agency (GOPCA) NPOP/NAB/0028	Mr B.M. Modi, Director, Beej PramananBhavan Opp. Gokul Row House, Nr. Shyamal Cross Satellite, Ahmedabad 380 015 Gujarat Tel : +079-26740031 Fax : +079-26740031, E-mail: dirgopca@gmail.com , Website: www.gopca.in
Uttar Pradesh State Organic Certification Agency NPOP/NAB/0029	Mr P.C Singh, Director, Government Garden Campus Kariyappa Road, Alambagh Lucknow 226 005 Uttar Pradesh Tel: +91 – 0522 – 2451639 Mobile: +917317001283 E-mail: upsoca.org@gmail.com, Website: www.upsoca.org
Karnataka State Organic Certification Agency NPOP/NAB/0030	Mr T. Ramachandraiah, Director, Opp. Baptist Hospital Bellary Road, Hebbal Bangalore, Karnataka-560024 Tel : +91 – 80- 23418302 FAX : +91 – 80 - 23415506 E-mail: ksocabng@gmail.com , Website: www.kssoca.in
Sikkim State Organic Certification Agency (SSOCA) NPOP/NAB/0031	Mrs Sherab L. Dorjee, CEO, Ground Floor, Soil Testing Lab Building, ICAR Complex, Tadong, Gangtok, Sikkim 737102 Tel: +91 – 03592-232494 FAX: +91 – 03592-232495 E-mail: ssoca2016@gmail.com , Website: www.ssoca.in
Global Certification Society NPOP/NAB/0032	Dr Subhash Chaudhary, Chairman, KesarBagh Colony, Mohal Nihang (Tika Nihang), near Dr Chaudhary Hospital, Palampur, H. P.- 176 061. Tel : 01894-234230 Fax: 01894-230131, E-mail: chairman@glocert.org ,Website:www.glocert.org
Green Cert Biosolutions Pvt. Ltd NPOP/ NAB/0033	Mr Neelesh Gharmalkar, CEO, Office 2, Building No.12, Runwal Meadow, Warje Pune 411 052 Tel: +91 – 9922488750 E-mail: greencert.pune@gmail.com , Website: www.greencert.in
Telangana State Organic Certification Authority NPOP/NAB/0034	Dr K Keshavulu, Director, HACA Bhawan, 1st Floor. 5-10-193, Opp. Public Garden Hyderabad 500 004 Tel: 040-23237016, 040-23235939 E-mail: tsscadir@gmail.com, Website: www.tsoca.telangana.gov.in

Annexure V

Maximum Residual Limit (MRLs) of insecticides in organic potato

(Source: *Jaivik Bharat*, https://jaivikbharat.fssai.gov.in)

S. No.	Name of insecticide	Tolerance limit mg/kg (ppm) for organic foods	Instrument to be used to achieve the LoQ
1.	Carbaryl	0.01*	LC-MS/MS
2.	Chlorpyrifos	0.005*	GC -MS/MS
3.	2,4-Dichlorophenoxy acetic acid	0.01*	LC -MS/MS
4.	Paraquat dichloride (Determined as Paraquat cations)	0.01*	LC -MS/MS
5.	Phosalone	0.005*	LC -MS/MS
6.	Thiometon (Residues determined as thiometon its sulfoxide and sulphone expressed as thiometon)	0.01*	LC -MS/MS
7.	Copper oxychloride (determined as copper)	0.05	AAS/ICP -MS
8.	Dithiocarbamates (the residue tolerance limit are determined and expressed as mg/CS_2/kg and refer separately to the residues arising from any or each group of dithiocarbamates	0.01*	GC -MS
9.	Chlorothalonil	0.01*	GC -MS/MS
10.	Malic hydrazide	2.5	LC -MS/MS
11.	Dimethomorph	0.005*	LC-MS/MS
12.	Propineb	0.025	GC-MS/MS

* MRL recommended at LoQ

Annexure VI

APEDA approved laboratories

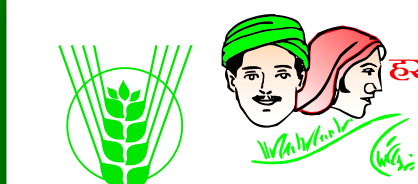
S. No.	Name of the laboratory
1	First Source Laboratory Solutions LLP, Hyderabad
2	National Collateral Management Services Limited (NCML), Hyderabad
3	Intertek India Pvt. Ltd., Hyderabad
4	Vimta Labs Ltd. , Hyderabad
5	Accurate Laboratory, Ahmedabad
6	SGS India Pvt. Ltd., Ahmedabad
7	Testtex India Laboratories Pvt. Ltd., Rajkot
8	International Testing Centre, Panchkula
9	SGS India Pvt. Ltd. , Gurgaon
10	TUV Sud South Asia Pvt. Ltd. Gurgaon
11	Auriga Research Limited, Bangalore
12	Eurofins Analytical Services India Pvt. Ltd., Bangalore
13	Shriram Institute for Industrial Research, Bangalore
14	TUV Sud South Asia Pvt. Ltd., Bangalore
15	Interfield Laboratories, Kochi
16	Ashwamedh Engineers & Consultants, Nashik
17	Centre for Food Testing, Bharati Vidyapeeth Deemed University, Pune
18	Envirocare Labs Pvt. Ltd., Thane
19	Geo Chem Laboratories Pvt. Ltd., Mumbai
20	MAARC Labs Pvt. Ltd., Pune
21	MicroChemSilliker Pvt. Ltd., Mumbai
22	National Horticultural Research & Development Foundation (NHRDF), Pesticide Residue Analysis Laboratory, Nashik
23	Reliable Analytical Laboratories Pvt. Ltd., Thane
24	TUV India Pvt. Ltd., Pune
25	Choksi Laboratories Limited, Indore
26	Arbro Pharmaceuticals Limited, New Delhi
27	Delhi Test House, Delhi
28	Shriram Institute for Industrial Research, Delhi
29	Punjab Biotechnology Incubator (PBTI), SAS Nagar, Mohali
30	Chennai Mettex Lab Private Limited, Chennai
31	Mats India Private Limited, Chennai
32	Nawal Analytical Laboratories, Hosur
33	SGS India Pvt. Ltd., Chennai
34	T A Labs Private Limited, Chennai

35	SMS Labs Services Private Limited, Chennai
36	AES Laboratories (P) Ltd., GautamBudha Nagar
37	DNA Testing Laboratory, Basmati Export Development Foundation (BEDF), Meerut
38	Edward Food Research & Analysis Centre Ltd. (EFRAC), Kolkata
39	SGS India Private Limited, Kolkata

Annexure VII

Useful Links for further information

1. Agricultural and Processed Foods Products Export Development Authority (APEDA): www.apeda.gov.in
2. ICAR-Central Potato Research Institute, Shimla -171001: www.cpri.icar.gov.in
3. *Jaivik bharat*: www.jaivikbharat.fssai.gov.in
4. National Center for Organic Farming: www.ncof.dacnet.nic.in
5. National Program for Organic Production: www.apeda.gov.in/apedawebsite/organic/organic_contents/national_programme_for_organic_production.htm
6. Participatory Guarantee System (PGS) India: www.pgsindia-ncof.gov.in/pgs_india.aspx
7. TraceNet : www.apeda.gov.in/apedawebsite/TracenetOrganic/TraceNet.htm



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