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GOOD AGRICULTURE PRACTICES FOR MEDICINAL PLANTS

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Abstract

Medicinal plants have complex and variable nature. They contain small amount of defined active ingredients so that control of starting materials, storage and their processing is very important. Cultivation, harvesting and primary processing of plant materials, which are used in the manufacturing of health products and herbal medicines, are often insufficiently monitored because the quantity of such preparation is to a large extent determined by the quality of the raw materials. Cultivation and harvesting of the same play a major role. To improve the quality of the medicinal plants monitoring of cultivation, harvesting and processing of the plant material good agriculture practices (GAP) have come into existence. The main aim in this Good Agriculture Practices is to insure that the plant raw material meets the demand of the consumer and the standard of the highest quality. It describes general principles and provides technical details for the cultivation of medicinal plants. It also describes quality control measures, where applicable. All participants of the production process (from primary producers to traders) are required to comply with these guidelines voluntarily and to elaborate practical measures in order to realize them.

Key words: medicinal Plants, GAP, quality control.

INTRODUCTION

Herbal medicines include herbs, herbal materials, herbal preparations and finished herbal products. Herbs include crude plant material such as leaves, flowers, fruit, seed, stems, wood, bark, roots, rhizomes or other plant parts, which may be entire, fragmented or powdered. The WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants are primarily intended to provide general technical guidance on obtaining medicinal plant materials of good quality for the sustainable production of herbal products classified as medicines. They apply to the cultivation and collection of medicinal plants, including certain post-harvest operations. Raw medicinal plant materials should meet all applicable national and/or regional quality standards. The guidelines therefore may need to be adjusted according to each country's situation.

The main objectives of these guidelines are to:

- Contribute to the quality assurance of medicinal plant materials used as the source for herbal medicines, which aims to improve the quality, safety and efficacy of finished herbal products;
- Guide the formulation of national and/or regional GACP guidelines and GACP monographs for medicinal plants and related standard operating procedures; and
- Encourage and support the sustainable cultivation and collection of medicinal plants of good quality in ways that respect and support the conservation of medicinal plants and the environment in general.

The safety and quality of raw medicinal plant materials and finished products depend on factors that may be classified as intrinsic (genetic) or extrinsic (environment, collection methods, cultivation, harvest, post-harvest processing, transport and storage practices). Inadvertent contamination by microbial or chemical agents during any of the production stages can also lead

to deterioration in safety and quality. Medicinal plants collected from the wild population may be contaminated by other species or plant parts through misidentification, accidental contamination or intentional adulteration, all of which may have unsafe consequences.

This section presents general guidelines on good agricultural practices for medicinal plants. It describes general principles and provides technical details for the cultivation of medicinal plants. It also describes quality control measures, where applicable.

Identification/authentication of cultivated medicinal plants

Selection of medicinal plants

Where applicable, the species or botanical variety selected for cultivation should be the same as that specified in the national pharmacopoeia or recommended by other authoritative national documents of the end-user's country. In the absence of such national documents, the selection of species or botanical varieties specified in the pharmacopoeia or other authoritative documents of other countries should be considered.

In the case of newly introduced medicinal plants, the species or botanical variety selected for cultivation should be identified and documented as the source material used or described in traditional medicine of the original country.

Botanical identity

The botanical identity scientific name (genus, species, subspecies/variety, author and family) of each medicinal plant under cultivation should be verified and recorded. If available, the local and English common names should also be recorded. Other relevant information, such as the cultivar name, ecotype, chemotype or phenotype, may also be provided, as appropriate.

For commercially available cultivars, the name of the cultivar and of the supplier should be provided. In the case of land races collected, propagated, disseminated and grown in a specific region, records should be kept of the locally named line, including the origin of the source seeds, plants or propagation materials.

Specimens

In the case of the first registration in a producer's country of a medicinal plant or where reasonable doubt exists as to the identity of a botanical species, a voucher botanical WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants specimen should be submitted to a regional or national herbarium for identification. Where possible, a genetic pattern should be compared to that of an authentic specimen. Documentation of the botanical identity should be included in the registration file.

Seeds and other propagation materials

Seeds and other propagation materials should be specified and suppliers of seeds and other propagation materials should provide all necessary information relating to the identity, quality and performance of their products, as well as their breeding history, where possible. The propagation or planting materials should be of the appropriate quality and be as free as possible from contamination and diseases in order to promote healthy plant growth. Planting material should preferably be resistant or tolerant to biotic or abiotic factors.

Seeds and other propagation materials used for organic production should be certified as being organically derived. The quality of propagation material - including any genetically modified germplasm - should comply with regional and/or national regulations and be appropriately labeled and documented, as required. Care should be taken to exclude extraneous species, botanical varieties and strains of medicinal plants during the entire production process. Counterfeit, substandard and adulterated propagation materials must be avoided.

Cultivation

Cultivation of medicinal plants requires intensive care and management. The conditions and duration of cultivation required vary depending on the quality of medicinal plant materials required. If no scientific published or documented cultivation data are available, traditional methods of cultivation should be followed, where feasible. Otherwise a method should be developed through research. The principles of good plant husbandry, including appropriate rotation of plants selected according to environmental suitability, should be followed and tillage should be adapted to plant growth and other requirements.

Conservation Agriculture (CA) techniques should be followed where appropriate, especially in the build-up of organic matter and conservation of soil humidity. Conservation Agriculture also includes "no-tillage" systems. Conservation Agriculture (CA) aims to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources combined with external inputs. It contributes to environmental conservation as well as to enhanced and sustained agricultural production. It can also be referred to as resource-efficient/resource-effective agriculture.

Site selection

Medicinal plant materials derived from the same species can show significant differences in quality when cultivated at different sites, owing to the influence of soil, climate and other factors. These differences may relate to physical appearance or to variations in their constituents, the biosynthesis of which may be affected by

extrinsic environmental conditions, including ecological and geographical variables and should be taken into consideration. Risks of contamination as a result of pollution of the soil, air or water by hazardous chemicals should be avoided. The impact of past land uses on the cultivation site, including the planting of previous crops and any applications of plant protection products, should be evaluated.

Ecological environment and social impact

The cultivation of medicinal plants may affect the ecological balance and, in particular, the genetic diversity of the flora and fauna in surrounding habitats. The quality and growth of medicinal plants can also be affected by other plants, other living organisms and by human activities. The introduction of non-indigenous medicinal plant species into cultivation may have a detrimental impact on the biological and ecological balance of the region. The ecological impact of cultivation activities should be monitored over time, where practical.

The social impact of cultivation on local communities should be examined to ensure that negative impacts on local livelihood are avoided. In terms of local income-earning opportunities, small-scale cultivation is often preferable to large-scale production, in particular if small-scale farmers are organized to market their products jointly. If large scale medicinal plant cultivation is or has been established, care should be taken that local communities benefit directly from, for example, fair wages, equal employment opportunities and capital reinvestment.

Climate

Climatic conditions, for example, length of day, rainfall (water supply) and field temperature, significantly influence the physical, chemical and biological qualities of medicinal plants. The duration of sunlight, average rainfall, average temperature, including daytime and night-time temperature differences, also influence the physiological and biochemical activities of plants and prior knowledge should be considered.

Soil

The soil should contain appropriate amounts of nutrients, organic matter and other elements to ensure optimal medicinal plant growth and quality. Optimal soil conditions, including soil type, drainage, moisture retention, fertility and pH, will be dictated by the selected medicinal plant species and/or target medicinal plant part. The use of fertilizers is often indispensable in order to obtain large yields of medicinal plants.

It is, however, necessary to ensure that correct types and quantities of fertilizers are used through agricultural research. In practice, organic and chemical fertilizers are used.

Human excreta must not be used as a fertilizer owing to the potential presence of infectious microorganisms or parasites. Animal manure should be thoroughly composted to meet safe sanitary standards of acceptable microbial limits and destroyed by the germination capacity of weeds. Any applications of animal manure should be documented. Chemical fertilizers that have been approved by the countries of cultivation and consumption should be used. All fertilizing agents should be applied sparingly and in accordance with the needs of the particular medicinal plant species and supporting capacity of the soil. Fertilizers should be applied in such a manner as to minimize leaching. Growers should implement practices that contribute to soil

conservation and minimize erosion, for example, through the creation of stream side buffer zones and the planting of cover crops and "green manure" (crops grown to be ploughed in), such as alfalfa.

Irrigation and drainage

Irrigation and drainage should be controlled and carried out in accordance with the needs of the individual medicinal plant species during its various stages of growth. Water used for irrigation purposes should comply with local, regional and/or national quality standards. Care should be exercised to ensure that the plants under cultivation are neither over nor under-watered.

In the choice of irrigation, as a general rule, the health impact of the different types of irrigation various forms of surface, sub-surface or overhead irrigation), particularly on the risks of increased vector disease transmission, must be taken into account.

Plant maintenance and protection

The growth and development characteristics of individual medicinal plants, as well as the plant part destined for medicinal use, should guide field management practices. The timely application of measures such as topping, bud nipping, pruning and shading may be used to control the growth and development of the plant, thereby improving the quality and quantity of the medicinal plant material being produced.

Any agrochemicals used to promote the growth of or to protect medicinal plants should be kept to a minimum and applied only when no alternative measures are available. Integrated pest management should be followed where appropriate. When necessary, only approved pesticides and herbicides should be applied at the minimum effective level, in accordance with the labeling and/or package insert instructions of the individual product and the regulatory requirements that apply for the grower and the end-user countries. Only qualified staff using approved equipment should carry out pesticide and herbicide applications. All applications should be documented. The minimum interval between such treatments and harvest should be consistent with the labeling and/or package insert instructions of the plant protection product and such treatments should be carried out in consultation and with the by agreement of the buyer of the medicinal plants or medicinal plant materials. Growers and producers should comply with maximum pesticide and herbicide residue limits, as stipulated by local, regional and/or national regulatory authorities of both the growers' and the end-users countries and/or regions. International agreements such as the International Plant Protection Convention⁵ and Codex Alimentarius should also be consulted on pesticide use and residues.

Harvest

Medicinal plants should be harvested during the optimal season or time period to ensure the production of medicinal plant materials and finished herbal products of the best possible quality. The time of harvest depends on the plant part to be used. However, it is well known that the concentration of biologically active constituents varies with the stage of plant growth and development. This also applies to non-targeted toxic or poisonous indigenous plant ingredients. The best time for harvest (quality peak season/time

of day) should be determined according to the quality and quantity of biologically active constituents rather than the total vegetative yield of the targeted medicinal plant parts. During harvest, care should be taken to ensure that no foreign matter, weeds or toxic plants are mixed with the harvested medicinal plant materials. Medicinal plants should be harvested under the best possible conditions, avoiding dew, rain or exceptionally high humidity. If harvesting occurs in wet conditions, the harvested material should be transported immediately to an indoor drying facility to expedite drying so as to prevent any possible deleterious effects due to increased moisture levels, which promote microbial fermentation and mold. Cutting devices, harvesters and other machines should be kept clean and adjusted to reduce damage and contamination from soil and other materials. They should be stored in an uncontaminated, dry place or facility free from insects, rodents, birds and other pests and inaccessible to livestock and domestic animals. Contact with soil should be avoided to the extent possible so as to minimize the microbial load of harvested medicinal plant materials. Where necessary, large drop cloths, preferably made of clean muslin, may be used as an interface between the harvested plants and the soil. If the underground parts (such as the roots) are used, any adhering soil should be removed from the medicinal plant materials as soon as they are harvested.

The harvested raw medicinal plant materials should be transported promptly in clean, dry conditions. They may be placed in clean baskets, dry sacks, trailers, hoppers or other well-aerated containers and carried to a central point for transport to the processing facility.

All containers used at harvest should be kept clean and free from contamination by previously harvested medicinal plants and other foreign matter. If plastic containers are used, particular attention should be paid to any possible retention of moisture that could lead to the growth of mold. When containers are not in use, they should be kept in dry conditions, in an area that is protected from insects, rodents, birds and other pests and inaccessible to livestock and domestic animals.

Any mechanical damage or compacting of the raw medicinal plant materials, as a consequence, for example, of overfilling or stacking of sacks or bags, that may result in composting or otherwise diminish quality should be avoided. Decomposed medicinal plant materials should be identified and discarded during harvest, post-harvest inspections and processing, in order to avoid microbial contamination and loss of product quality.

Personnel

Growers and producers should have adequate knowledge of the medicinal plant concerned. This should include botanical identification, cultivation characteristics and environmental requirements (soil type, soil pH, fertility, plant spacing and light requirements), as well as the means of harvest and storage.

All personnel (including field workers) involved in the propagation, cultivation, harvest and post-harvest processing stages of medicinal plant production should maintain appropriate personal hygiene and should have received training regarding their hygiene responsibilities.

Only properly trained personnel, wearing appropriate protective clothing (such as overalls, gloves, helmet, goggles, face mask), should apply agrochemicals.

Growers and producers should receive instruction on all issues relevant to the protection of the environment,

conservation of medicinal plant species and proper agricultural stewardship.

Sample record for cultivated Medicinal Plants
Identification of cultivated medicinal plants

Scientific name (genus, species, author, family): _____
Local name: _____
English common name (if known): _____
Plant part for harvest: _____
Crop code no.: _____

Identification of cultivation site

Field location: _____
Province/state/country: _____
Identification of cultivator
Name of cultivator: _____
Contract address: _____
Date (dd/mm/yyyy) cultivation begins: _____ Date (dd/mm/yyyy) cultivation ends: _____

Seeds and propagation materials

Source of the planted material: _____
Physical description of the plant material: _____
Commercial; available (circle): yes/no
If yes, name of cultivator: _____ Name of supplier: _____

Cultivation

Method of propagation materials establishment (circle): direct seed sowing/transplants
Date of first sowing/planting: _____ Percentage emergence: _____
Date of re-sowing/planting: _____ Percentage stand establishment: _____
Distance between rows (cm): _____ Distance between plants (cm): _____
Size of planted area (m²): _____ Number of plants per unit area: _____
Crop rotation: _____
Type of soil: % Clay _____ % Sand _____ % Silt _____ % Organic matter _____ % Others (describe) _____
Soil pH: _____ Soil fertility (circle): good/poor
Soil moisture retention (circle): good/poor
Soil drainage (circle): good/poor
Irrigation (circle): yes/no Land (circle): even/sloping
Type of irrigation (circle): flood/furrow/sprinkler/drip
Source of water (circle): municipal piped supply/lake/river/well/other
If other, please specify: _____
Quality of water: good/bad Description: _____
Salt content in water(circle): low/high
Name of adjacent plants: _____
Insects on adjacent plants (circle): Aphids/scale/catterpillars/locust/other
If other, please specify: _____

Agrochemicals

Fertilizer applied before planting (circle): organic (composted animal manure)/chemical
Name: _____ Method: _____
Time/date (dd/mm/yyyy): _____ Rate: _____

Herbicides applied before planting

Name: _____ Method: _____
Time/date (dd/mm/yyyy): _____ Rate: _____

Herbicides applied after planting

Name: _____ Method: _____
Time/date (dd/mm/yyyy): _____ Rate: _____

Pesticides applied

Name : _____ Method: _____
Time/date (dd/mm/yyyy): _____ Rate: _____

Harvest/Collection

Date of harvest: _____ Time of day: _____
Conditions: _____ Method: _____
Yield: _____
Unusual circumstances that may influence quality (extreme weather conditions, exposure to hazardous substances, pest outbreaks, etc.): _____

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