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A Review on good agricultural practices laid by World health Organisation

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Abstract

Plant based medicines have gained great importance and huge demand at global markets in the past few decades. Despite this demand, the supply of good quality raw drugs is poor due to large scale destruction of plant biodiversity in the wild habitat. This has led to adulteration of the medicinal herbs. Thus, there is an immediate need to adapt proper techniques of plant cultivation and their preservation for an outcome of high grade herbal products. The climatic factors, fertile land, maintenance of plant protection, timely harvesting, post-harvest methods, storage and transport of plant materials have a major influence in plant production of excellent quality. Hence, this article gives a brief insight into guidelines for good agricultural practices for better yield of raw drugs.

Keywords: Good agricultural practices; WHO; Cultivation; Harvest; Post-harvest.

Introduction

Secretariat of the Convention on Biological Diversity, states that the total global sales of herbal products estimated US\$ 60,000 million in 2000¹. This indicates the demand for medicinal herbs at national and global markets. Besides, there is a wide encroachment of forest areas, loss of biodiversity of plants, non-availability of proper techniques or authentic plantation material, lack of education which has led to adulteration and substitution. As a consequence, the safety and quality of herbal medicines have increasingly become a major concern for health authorities and the public alike.

An Informal Meeting of World Health Organization (WHO) on Methodologies for Quality Control of Finished Herbal Products was held at Ottawa, Canada on 20th and 21st July 2001 which reviewed the entire process of production of herbal medicines from raw materials to finished herbal products. During this meeting it was recommended that WHO should give high priority to the development of globally applicable guidelines to promote the safety and quality of medicinal plant materials. Thus, WHO has developed a series of technical guidelines relating to the quality control of herbal medicines on good agricultural practices ^[1].

Good Agricultural practices (GAP) are specific methods which, when applied to agriculture, produce results that are in harmony with the values of the proponents of those practices ^[2].

Objectives of GAP

Quality assurance of medicinal plant materials used as the source for herbal medicines aimed to improve the quality, safety and efficacy of finished herbal products and to act in accordance with the guidelines of GAP for medicinal plants and related standard operating procedures are the prime objectives of GAP framed by WHO ^[1].

Identification, cultivation, harvest management, post-harvest processing, bulk packaging & labeling, storage & transport of crude medicinal plant material are the parameters on which these guidelines are laid.

1. Identification of medicinal plants: The plant selected should be specified in the national pharmacopeia or recommended in authoritative national documents. If the plant selected is unknown or newly introduced, its identification as a source material is to be documented. Botanical identification of the plant is to be verified and documented in the following order: genus, species, sub-species, author- who discovered the plant, family, local name, English common name, officinal part ^[1].

2. Cultivation: The factors that influence the cultivation of a plant are: climatic conditions, selection of land, soil preparation, manure application, seed & propagation material, irrigation

practices and plant protection ^[1].

2.1 Climatic conditions: The day length i.e. the time between sunrise and sunset, amount of rainfall, its distribution and intensity, temperature and humidity have influence over plants. For instance, *Cinchona officinalis* requires an annual rainfall of less than 200 mm ^[3] while *Bacopa monnieri* (Linn.) Pannell grows well in the temperature ranging between 30^o- 40^o C with a humidity of 65 – 80% ^[4].

2.2 Selection of land: The considerations while selecting a land are as follows: to know the history of field, to assess the fertility of soil, check for availability of water source, land should not be near the place of chemical contamination, it should have minimum or no risk of soil / water / air pollution, check for any possible contamination from neighbouring plots or any prevalent pests in that land, and then signpost the land where the plant is to be grown ^[5].

2.3 Soil preparation: It plays a very important role in the cultivation of plants. Type and pH, nutrients, microbes, moisture, drainage of soil are essential factors for the growth of the plant. It is reported that *Bacopa monnieri* (Linn.) Pannell thrives well in clayey loam to clayey soils and a pH of 7.5 and even more ^[6].

2.4 Manure application: Manure is any organic substance obtained by decomposition of animal waste and plant residue ^[7]. Documentation of manure application is done which states date, origin, amount, name of the producer, type of treatment, worker and place of application ^[5]. Common types of manure include

2.4 a) Farm yard manure: It is a decomposed mixture of cattle dung, remnants of straw and plant stalks fed to cattle. Partially rotten manure application is done to soil three to four weeks before sowing and complete rotten manure is to be applied just before sowing ^[7].

2.4 b) Green manure: This is obtained by quick growing medicinal plants and ploughed it under to incorporate it into the soil while green ^[8].

2.4 c) Vermicompost manure: This is a product prepared using various worms viz. red wrigglers, white worms and other earth worms ^[9].

2.5 Seed and propagation material: The material should be resistant to biotic or abiotic factors, free from any contamination and disease. It should adapt to the soil. Extraneous, counterfeit, substandard, adulterated material should be excluded. Suppliers of the material should provide necessary information such as identity, quality and breeding history of the material ^[1]. Analysis of the crop to be grown as a monocrop or intercrop and if required pre-treatment of the material is to be done. Documentation of propagation includes method of propagation, date of propagation, distance between rows, distance between plants, size of planted area, number of plants per unit area ^[5].

2.6 Irrigation practices: Irrigation is an artificial application of water to land or soil. While irrigating, irrigating method, source of water, season, duration and frequency need to be considered and carried out in accordance with the needs of the individual medicinal plant species during its various stages of growth ^[1].

2.7 Plant protection: Like humans, plants also get afflicted with various diseases and they need proper treatment. Natural pesticides like extracts of *Ocimum sanctum* Linn, *Aloe vera* Linn, *Azadirachta indica* Juss, *Vitex negundo* Linn, *Acorus calamus* Linn ^[10], etc and various agrochemicals are used to treat them. Application of a registered chemical whose bad state or due date is to be verified ^[4] and it should comply maximum residue limit ^[1]. The time interval between each application and time period between an application and harvest is to be maintained ^[1].

3. Harvest: It reflects upon economic aspect of a country. Different parts of the plant are collected depending upon various factors like underground parts are to be collected when aerial parts show signs of senescence. Stem part is collected when plant begins to flower (cut 5-10cms above the ground). Leaves are collected throughout growing period. Flowers are collected just after they have opened while fruits & berries when they ripen but are firm. Bark is collected when plant shed leaves and sap when bark readily detaches from wood ^[11]. Specific devices are used for harvesting various parts of plants. A very few to mention are the diggers for underground parts, binders for aerial parts, seed strippers for flowers / seeds / fruits etc. which should be clean with proper maintenance ^[1]. Harvested plant materials are to be transferred to dry & non-contaminated conditions viz. dry sacks/bags and well aerated containers. Avoidance from dew / rain / high humidity, mixing with any foreign matter / weeds / toxic plants / decomposed plants, adhering soil in the underground plant parts, overfilling / stacking of sacks are some of the precautions to be taken while transferring the harvested material ^[1].

4. Post- harvest processing: Inspection and primary processing are the two procedures done in post-harvest period. Inspection involves visual inspection for cross-contamination by untargeted medicinal plants and / or plant parts, for foreign matter and or/*ganoleptic evaluation such as: appearance, damage, size, colour, odour, and possibly taste. Primary processing is applied to freshly harvested plant materials. Drying, peeling, soaking, chopping, liming, fermentation, fumigation are some of the processing methods ^[1].

5. Bulk packaging & labeling: Packaging used should be agreed upon between supplier and buyer ^[1]. Packaging material should be selected based upon climatic, morphological and chemical conditions ^[12]. The material chosen should be non-polluting, clean, and dry & confirm to the quality requirements. Fragile medicinal plant materials are to be packed in rigid containers, reusable packaging material like jute sacks & mesh bags should be disinfected & dried prior to reuse ^[1].

The packed material should be labeled with the following information - scientific name, plant part, place of origin, date of collection / cultivation, names of growers, quantity, quality approval of the material, number of production batch ^[1].

6. Storage & Transport: Dried products & essential oils should be stored in dry, well aerated buildings / containers, fresh products are stored between the temperatures 1^o C & 5^o C while frozen products are stored below (-20^o C) ^[13]. Aerated transport vehicles are used for transportation. Essential oil transport must confirm to regulations. Fumigation against pest attack during transportation if needed can be done. Frozen storage & saturated steam is used for pest control ^[13]. Type & amount loaded, name of the worker, driver, and origin are to be registered before transportation ^[5].

Discussion

Producer, processor and the trader of the raw materials are the section of people to follow the guidelines of good agricultural practices^[14].

Similar names are attributed to more than one plant and single plant has different names in different geographical regions leading to confusion at the very beginning of collection process. Thus, to avoid the confusion and for easy understanding identification of plants need to be established in prior.

Plants require sunlight to synthesize food by means of photosynthesis. Optimum sunlight throughout day helps the plants to produce food through photosynthesis. The decrease in the quantity of sunlight decreases process of photosynthesis seen at night^[15]. Thus, maximum growth takes place during day than night. The analysis of amount, distribution and intensity of rainfall helps in taking decisions of sowing period, scheduling of irrigation and time of harvesting. The growth of the plant is related with the temperature. Higher the temperature, the rate of photosynthesis is more while the lower temperature results in poor growth due to reduced photosynthesis^[15]. Humidity maintains turgor pressure and transports nutrients throughout the plant. Transpiration in plants is regulated via this turgor pressure^[15]. pH of the soil influences plant growth. High alkalinity of the soil chemically ties up the micronutrients such as iron, zinc, copper and manganese while calcium, phosphorus, magnesium become tied up due to increased acidity in the soil and thus become unavailable to the plants^[15]. Soil is a major source of nutrients needed by plants for energy transfer from sunlight, resistance to diseases, development of different parts of plant and thus overall plant growth^[16]. Microbes in soil breakdown organic matter, make nutrients available for uptake by plants and maintain soil structure^[17]. Moisture content and drainage of the soil are important to improve the production and to manage water supplies. Farm yard manure improves soil tilth and aeration, increase water holding capacity of soil, stimulates activity of soil microbes, enables plant food elements available to crop. Both farm yard manure and green manure protect against soil erosion and leaching, provides an additional supply of nitrogen^[7, 8]. Vermicompost manure contains a high saturation of nutrients and has reduced levels of contaminants^[9]. Irrigation ensures plant protection against frost, prevents soil consolidation^[18]. *Ocimum sanctum* Linn. Has both repellent and herbicidal properties. Juice of *Aloe vera* Linn. Possess anti-fungal and anti-bacterial effects. The alcoholic extract of *Acorus calamus* Linn. Inhibits the growth of certain fungi. The extract of *Azadirachta indica* Juss. Is effective against pests such as nematodes^[10].

Drying plays a major role in post-harvest processing as it helps in removal of sufficient moisture content, improves quality, enhances resistance to growth of micro-organisms, inhibits partially enzymatic reactions and facilitates pulverizing.

Conclusion

Guidelines for good agricultural practices have greater impact on the herbal medicine manufacturing industries since plants are major source for the finished products. To ensure potent and efficacious herbal formulations following good agricultural practices from cultivation to raw drug transport must be followed. Adulteration of various medicinal plants can be avoided to a greater extent with the aid of good agricultural practices and meet the demand for the herbal products at national and international herbal markets.

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