

## CHALLENGES OF IMPLEMENTATION OF GOOD AGRICULTURAL PRACTICES IN *KURDISTAN REGION, IRAQ*

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### Abstract

Overall, the application of good agricultural practices in Kurdistan region, Iraq is based on the general concept of integrated crop management. The good agricultural practices are essential components of environment-friendly and economically viable production systems relying on modern technology and aimed at producing high quality food in an efficient manner. Good agricultural or better horticultural practices (GAP) should consist in a set of most suitable tools to guarantee quality and assure safety for consumption. All kind of production should utilize GAP technologies, whether in integrated or organic cultivation. Good Agricultural Practices (GAP) are internationally acknowledged measures for decrease a risk as a result of pesticide and fertilizer use and they aim at protecting of human health and stabile agricultural development free of environmental contamination. Their initiating in Kurdistan region, Iraq is forced by the world globalization and opening of the markets that places the food quality and safety in the foreground. In view of obtaining safe and healthy food and noon food agricultural products taking also into account economical social sustainability, in recent years have been proposed and implemented Good Agricultural Practices (GAP), representing a collection of principles to be applied to on-farm production and post-production processes. In the context of rapidly changing and globalizing food economy the concept of GAP has evolved in recent years. Therefore the GAP is becoming an increasingly important issue for many production area regardless the level of intensification of production processes.

**Key words:** Good agricultural, practices, safty food, environment, human health, economics, sustainable development

### Introduction

Good agricultural practices are considered with the requirements of the European legislation to the factors of the working conditions for safety and healthful labor conditions, set in a number of regulation documents. GAP is developed according the requirements of the European Community legislations about:

- Soil and water protection;
- Plant protection from diseases, pests and weeds by applying of preventive measures and methods for integrated control;
- Requirements for use of fertilizers, composts, biologically active substances, nutritive substrates and products for plant protection.

The methods on which GAP are based rely on the amount and quality of produced food, on the protection of natural resources, on the maintenance of farming enterprises viability, the meeting pf social demand. Many aspects are considered in the GAP (e. g.: water, soil, fertilization, etc.), however no specific reference is made to propagation material as a starting condi-

tion for a „good“ production process; this in spite the role that the quality of propagates on crop response may play. GAP must include physical, chemical and biological measures to meet all safety standards for quality fruits and vegetables. Here hide constraints which must be overcome. All operational inputs are of concern and have to be carefully analyzed such as soil, water, choice of seeds and cultivars, necessity, timing and application of agrochemicals, application of organic and inorganic fertilizers, resulting in good integrated crop (ICM) and integrated pest management (IPM), and even handling of labor.

### 1. GAP in Greenhouses

Specifically in greenhouses, the good agricultural practices include mainly:

- a. Use of biological methods for pest control whenever possible;
- b. Selective use of low-toxicity pesticides where there is severe pest infiltration but detailed records must be kept;
- c. Controlled entry of personal inside the greenhouse;

- d. Other non-chemical plant protection measures, such as insect nets and photo-selective covering materials;
- e. Modern equipment allowing for maintenance of optimal climatic conditions inside the greenhouse;
- f. Balanced fertilization and irrigation based on soil analysis and crop demand;
- g. Control of soil-borne pathogens by non-chemical means, such as grafting, soil solarization, and soilless culture;
- h. Use of pollinating insects (bumblebees) for fruit setting in fruit vegetables.

Under greenhouse conditions crop establishment must be carried out adopting seedlings with high qualitative standards and capable of adapting to conditions which could be encountered under intensive agroecosystems. However, while genetic and sanitary quality is well defined, agronomic qualitative parameters should be better identified. Simple methodologies to define these characters must be individuated; besides, qualitative standards have to be defined according to: crop agrosystems, species, cultivars, seedling typologies, etc.

## 2. Good agriculture practices in seedling production

„Well begun is half done“ - Good Agricultural Practices aim in seedling production is producing of healthy seedlings with high qualitative characters without any risk of soil and water contamination.

In protected cultivations, as well as in other intensive production agrosystems, good quality propagation material should be adopted considering that growers more and more frequently demands for seedling vigor and size suitable for a good crop performance. Seeds and other propagation materials should be specified and suppliers 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 of planting materials must have the appropriate quality and be free from contamination and diseases in order to promote healthy plant growth. Planting material should preferably be resistant or tolerant to biotic or abiotic factors.

According to EU regulation the quality of propagation material should comply with regional and/or national regulations and be appropriately labeled and documented, as required. In the last decades thanks to different national and EU

regulations we observed an implementation of the standards and conditions with respect to varieties identity and purity, biological and physiological value, health status with respect to harmful organisms which affect the quality of the plant material in conjunction with quarantine pest/diseases, etc.

For this reason seedling industry has greatly improved and specialized during last decades and is now capable of producing seedlings with well defined characteristics differing in relation to grower demand. Those characteristics mainly concern rhizosphere volume and shape, root growth, seedling height, number of true leaves, presence or not of flower bud. In general a “good” vegetable transplant should be green, pest-free, with well developed root system, strong stems, a sufficient leaf number (varying according to specie and growing conditions) and have an high percentage of chlorophyll. The plantlets once transplanted should establish quickly and continue to growth. Grafting on pest and disease resistant rootstocks is currently also tested as an alternative to soil sterilization, especially in crops susceptible to *Fusarium*. Nevertheless, grafting does not provide protection against all soil-borne pathogens, insects, nematodes and weeds, and, therefore, it cannot be considered a complete substitution for methyl bromide.

GAP is a set of technological requirements for seedlings growing that are a premise for production of qualitative seedlings, including the following:

- a. The choice of the variety should be based on the period on cultivation and its continuance, growing technology and properties of the variety - disease resistance, earliness, productivity, habit and quality of the produce.
- b. The seeds should be authentic, certified, treated; classified, sized and with high sowing qualities -
  - Seed germination over 96%;
  - Purity of the variety over 98%;
  - Moisture 6-8%.
- c. The nutritive medium should be uniformed, weed seeds free and pathogen free. It should maintain favorable for plants both air-water and nutritive regime.

On the other hand some cultivars should be taken into consideration, these rely mainly on the outstanding number of cultivars (from local eco-

types to F1 hybrids) and species and on the diversification of seedling typologies (e.g.: organic, topped, grafted, etc.). Therefore possible strategies could be the result of a better understanding of cause effect relation between seedling characteristic and crop performance and to the integration of information related to transplant production for raising seedling with definite characteristics.

### 3. Rules for good agriculture practices in soil fertility regulation and improvement

Greenhouse production of vegetables and flowers creates a real risk of a soil fertility deterioration and produce ecological properties worsening. It results both in the natural processes of degradation and in intensive anthropogenic work. The rules for Good Agricultural Practices are a collection of cultural methods that share the environment and their application helps for supporting of the ecological balance for regulation and improvement of soil fertility, for production of high quality produce.

GAP requires monitoring of agrochemical properties of the soils and creation of correct system for nutrition and efficient and rational use of fertilizers on the basis of the soil and plant chemical analysis. The rules, requirements and time limits for taking of soil and plant samples were developed in EC and this is the first and most important stage of the soil agrochemical study. Good Agricultural Practice requires fertilizers, composts, biologically active substances, nutritive substrates and other soil-improvers that are used to cover the conditions fixed in the law and regulation documents in the EC. A complex of coordinated measures in the system of fertilization aims at the rational and efficient using of fertilizers in the growing crop conditions is included in the GAP. The choice of the terms for fertilizer applying and the ways of fertilization aim at providing the plants with nutritive substances during the whole vegetation period. In fertilization Good Agricultural Practice is confirmed with the kind of used fertilizers and their effect on the soil fertility, the level of the nutritive elements remaining in the soil and the requirements of the growing crop.

GAP in use of organic fertilizers requires the following:

- Preliminary composting of the fertilizers that increase the humus content of the soil rapidly at a reduced risk of its infes-

tation with pathogens and running through weed seeds.

- Do not use none-decomposed or slightly decomposed manure and chicken manure especially in fertilizing.
- „Manure solution“ could be applied only in cases when the distance to the surface water sources (rivers, water courses, channels, lakes, artificial lakes, seas etc.) is not smaller then 5 m.

Good Agricultural Practice in mineral fertilization includes activities that protect the soil from diffusive contamination and/or unfavorable change of the nutritive regime:

- It's impossible a single application of a great amounts of fertilizers.
- Application of ammonium fertilizers immediately after liming is not permitted. This result in ammonium poisoning of the plants, contamination of the atmosphere and loss of nitrogen.
- Use of great doses of ammonium fertilizers in months with poor light conditions is not permitted in order to avoid the ammonia blight of the plants.
- Do not use ammonia fertilizers in acid soil.
- The required nitrogen rate to be applied in a small doses and do not allow one-sided nitrogen fertilization because it results in a number of negative effects - overgrowing in the vegetation period, increase of the risk from diseases and pests, vegetation period prolongation, delay of ripening etc.
- Use of chlorine-containing potassium fertilizers is not recommended, especially in crops susceptible to chlorine - tomato, cucumber and melon.
- The soluble fertilizers to be applied in small doses and in short intervals.
- Fertilization in zone II of the sanitary-protected area from the water sources for public water-supply where the nitrate content is higher then 25 mg/l is forbidden.

Good agricultural practices in use of the bio-products in the greenhouse production is a collection of cultural manners and their application increases the effectiveness of the bio-products as an alternative of mineral fertilization and as ecological solution for soil fertility improvement. This is as a result of the improved soil microflora and/or the applied humus and biological

active substances. GAP requires obligatory use of bio-products, containing useful microorganisms after biocide soil treatment (fumigation, steaming) in order the soil micro-flora to be restored quicker and in compost production - to accelerate the composting and to increase the compost quality. Good Agricultural Practices includes a complex of coordinated measures from the system of fertilization aiming at not permitting soil acidification and salting as degenerative processes harmful both for soil fertility and for the plants:

- Application of organic fertilizers for improvement of the buffer and water-keeping soil ability.
- Fertilization with mineral fertilizers accordingly their hydrolytic and physiological reaction and the soil response.
- Correction of the soil response by liming, gypsuming or cultural methods.
- Irrigation with waters possessing qualitative characters according to the EC Community Standards, and National Standards.

GAP recommends farmers to keep review documentation where they should record all important details from their production practice and to safe the data. GAP includes the following prohibitions and they refer to all farmers:

- Do not throw away fertilizer and packing remains in the surface waters and in deserted wells;
- Do not wash the packing, special clothing and equipment connected with fertilization in rivers, artificial lakes and other surface water places;
- Do not store organic and mineral fertilizers on the areas near to water sources or rivers.

#### 4. GAP and pest control

In addition to the use of non-chemical pest control methods for the above-ground parts of the plants, it is essential to restrict the application of pesticides also for the control of soil-borne pathogens. According to the Montreal protocol, the use of methyl bromide as a soil fumigant was phased out since 2005 in the developed countries, while a phase-out from the developing countries has been scheduled for 2015. To cope with this new situation, various alternatives are currently proposed and tested against soil-borne pathogens.

Soil sterilization by means of steam pasteurization is an old and well-proven practice. Application of 71°C for 30 minutes is sufficient to kill all soil-borne pathogens except few resistant weed seeds and some plant viruses, while preserving many thermophilic beneficial microorganisms. The main reason for the poor interest in this method is the cost of purchasing a steam generator, which is too high for most growers.

Grafting on pest and disease resistant rootstocks is currently also tested as an alternative to soil sterilization, especially in crops susceptible to *Fusarium* (Solanaceae, Cucurbitaceae). Nevertheless, grafting does not provide protection against all soil-borne pathogens, insects, nematodes and weeds, and, therefore, it cannot be considered a complete substitution for disinfection with methyl bromide.

Substitution of methyl bromide by other chemicals, such as metam-sodium, 1,3 dichloropropene (1,3-D), chloropicrin, and their combinations have also been tested. However, the application of these chemicals requires long plant-back periods, otherwise phytotoxicity may occur. Furthermore, these chemicals are not effective against all soil-borne diseases. The inoculation of the greenhouse soil with suppressive soils containing fungi and bacteria species, which act antagonistically to certain pathogens, might be an environment friendly alternative to methyl bromide. However, the microorganisms tested up to date are specialized against one or, at best, a few pathogens, and can be used only when these particular pathogens or pests constitute a serious threat for the crop. Soil solarization is one of the most promising alternatives to the use of methyl-bromide disinfection in greenhouses. This technique is based on trapping the visible and ultra-violet solar energy in the greenhouse soil by means of a polyethylene sheet, which is used as an air and water-tight cover on its surface. Normally, most of the visible and ultra-violet radiation absorbed by the soil is converted into thermic energy, which is re-emitted back to the environment as infra-red radiation.

#### 5. General consideration for greenhouse GAP

The establishment of new greenhouses and the modernization of already existing installations should essentially be based on a functional design aimed at optimizing the greenhouse environment while minimizing the need for agrochemicals. Greenhouse facilities enabling maintenance of optimal climatic conditions inside the

greenhouse constitute a prerequisite for the application of good agricultural practices.

A functional greenhouse design includes among others sufficient static strength, optimal orientation depending on the location and the topography, use of covering materials and structures resulting in minimal reduction of light transmission inside the structure (>80%), and sufficient greenhouse equipment taking into consideration the climatic conditions of the location, the crop needs, the target growing season, the fuel, land, and water availability, and the cost. Overall, tall greenhouse structures (3-6 m) are preferable since they provide more space for plant elongation, enhanced CO<sub>2</sub> reserves and a more efficient buffering of the inside temperature. Sub-optimal greenhouse height is a serious problem, which restricts their prospects to provide high yields and optimal produce quality.

The problems arising from an insufficient greenhouse height include large temperature and humidity fluctuations during day and night, and the imposition of short growing seasons in fruit-bearing vegetables, which otherwise would have a potential for long-term production (e.g. tomato).

The use of fine-mesh screens to reduce insect entry into the greenhouse has become a common practice in many countries during the last years. Insect exclusion by means of screened openings is a fundamental measure within the frame of Integrated Crop Management (ICM) strategies in greenhouses, since it is an effective means not only to reduce insect damage but also to avoid virus infections. This problem may be tackled by increasing the surface percentage of vent openings. Another non-chemical method of pest control in greenhouses is the use of photo-selective covering materials, which may influence the insect activity inside the greenhouse. The photo-selective plastic sheets with plant-protective attributes contain specific substances which reduce or even eliminate the transmission of ultra-violet (UV) radiation (280-400 nm). The absence of UV radiation in the spectrum of the incoming solar radiation results in insect disorientation, thereby considerably restricting their activity inside the greenhouse, while the yield is not affected by this treatment.

## 6. GAP in open field plant cultivation

Monoculture producing cannot be applied, except for annual fodder, bee pastures and green manure plants:

- For crop rotation the following guidelines must be applied:
- Sugar beet, beetroot, turnip, potato, field bean, soy and lupine can be grown in the same field only once in every four years;
- Sunflower can be grown in the same field only once in every five years;
- At least once in every five years papilionaceae or green fodder must be grown in the rotated field, including successive secondary crops;
- Dried peas can be grown only once in every seven years;
- Maize can be followed only by plants of low nitrogen need;
- At least two-year period of lapse must be kept between the growing of two non-annual papillonaceae;
- Alfaalfa cannot be followed by any other papillonaceae, and after Alfaalfa, the follow-up crop must be of high nitrogen need;
- Soy, sunflower and summer rape cannot follow one another;
- In the crop rotation the joint rate of spicate and maize cannot exceed 75%.
- Mechanic weed control must be carried out prior to weed flowering.
- Application of soil preparation at different depths annually.
- Straws bales must be removed from the field within one month after gathering.

## 7. GAP in Nutrient management

- Focused soil analysis is required in every five years (pH, humus content, KA, total of water soluble salts, CaCO<sub>3</sub>, NO<sub>2</sub> + NO<sub>3</sub>, P<sub>2</sub>O<sub>2</sub> and K<sub>2</sub>O)
- Soil improvement and spreading of treated sewage, sewage sludge and liquid livestock waste can be carried out with the consent of the plan and soil protection service in accordance with the relevant regulations.
- When applying nitrogen fertilizers, farmers must not exceed the maximum values calculated for unfavorable and non

- unfavorable areas, as well as nitrate sensitive and non-nitrate sensitive areas.
- In nitrate sensitive areas it is obligatory to follow the regulations of the action program (determined by governmental decree).
  - In non-nitrate sensitive areas the following regulations are applicable:
    - a. Manure can be spread to steeper slopes as long as it is incorporated promptly.
    - b. It is forbidden to spread manure within at least ten meters of water source, such as well that supplies human or animal consumption, as well as floodplains and immediate areas of watercourses.
    - c. Quick acting, soluble nitrogen fertilizers, addle and liquid waste can only be spread after harvesting in the same year, if less than fourteen days have elapsed between the spreading and the sowing of the cover crop.
    - d. It is forbidden to spread manure when the soil is frozen hard (the soil is frozen to the depth of five centimeters), waterlogged or snow covered.
    - e. Soil manure must be kept in an impermeable manure store with a collection channel and a below-ground tank to hold leechate, which has a storage capacity of at least eight months of livestock waste. Liquid waste is to be kept in an impermeable storage tank or lagoon with a storage capacity of at least four months of waste material.

### 8. GAP in pest control

Only authorized pesticides and fertilizers can be used, in compliance with technological and licensing regulations. Pesticides must be kept in a store room or cabinet which is locked and separated from other rooms housing people or animals or used for storing human or animal food, in a way which prevents fire or explosion, and damages to health and the environment (in accordance with ministry orders on pesticide circulation and application, and the packaging, labeling, storage and transportation of pesticides). It is forbidden to store pesticides within at least one kilometer from:

- the full length of the coastlines, and other natural waters designated for swimming;
- protective areas around waterworks and water resources.

Empty packages and wrappings of pesticides must be collected, treated and disposed of in accordance with the relevant regulations. The machinery and pesticide spreaders used to protect plants must be in perfect technical condition.

### 9. GAP for Conservation and landscape protection (in nature reserves and environmentally sensitive areas)

Farmers should avoid damaging natural or semi-natural habitats when performing an agricultural activity (plowing, spreading manure or chemicals, or destroying landscape components). Farmers should avoid damaging or ruining historical and architectural monuments and sites situated in the territory of the farm. Farmers cannot alter the size of the parcel of land. Ameliorative liming, drainage and irrigation are forbidden.

Farmers are only allowed to apply environmentally favorable mowing methods and technologies (starting to mow from the center of the land, leaving edges to the end).

Construction of temporary or permanent buildings is possible only with the consent of the management of the given national park.

The time for mowing on protected marshes must be determined on an individual basis by consulting the experts of the given national park.

Existing alleys, forest belts and old trees must be protected. In the course of technological operation related to cultivation (haystacks, bales, manure heaps etc.) can only be created on cultivated land. Upon finding nest of increasingly protected birds, farmers must immediately report it to the given National Park. Only natural material (wood, cane) are allowed to be used to build night shelter for animals.

Shepherds' accommodation must fit in with the landscape and be built by using traditional building materials and methods. Ponds and inland water spots must be preserved.

### 10. GAP in soil erosion

In areas exposed to erosion, the soil must be protected with crop cover until the sowing of spring crop.

- Contour cultivation is required in areas exposed to erosion.
- Terraces established to prevent erosion must be preserved.
- It is forbidden to grow root crops on slopes with an angle higher than 12 percent.
- Green stripes (hedges, field borders) are to be preserved.
- Operations resulting in soil opening must be followed by soil closing operations

The increasing concern of consumers with the safe and quality of fresh vegetables and other food products originating from agriculture forced the large super market chains in Europe to establish a comprehensive system of certification. This system is based on the establishment of GOOD AGRICULTURAL PRACTICES in form of specific protocols that should be implemented by growers who wish to obtain certification for their products. This certification system, which was known as EUREPGAP up to last year, was recently renamed into GLOBALGAP. The application of the prescribed good agricultural practices is aimed at minimizing detrimental environmental impacts of farming operations, reducing the use of chemical inputs and ensuring a responsible approach to worker health and safety ([www.globalgap.org](http://www.globalgap.org)). A major characteristic of this system is the traceability of the product with respect to the delivery chain from the field to the shelf, which increases the responsibility of the growers. Traceability aims at ensuring that all food products are documented at every step of food production, delivering, and distribution. Certification of the production procedure according to the GLOBALGAP standard is a prerequisite for the product to be marketed by joined retailers. The introduction of the GLOBALGAP certification system had serious consequences on greenhouse vegetable production, since it is currently a prerequisite for greenhouse growers who wish to export their products to the large fresh vegetable markets of Europe.

#### 11. Organic Culture in Kurdistan Region of Iraq

Organic culture was and still the dominant Agricultural mode in Kurdistan Region. Since, the most of farms especially fruit trees orchards are highly depending on organic manures for increasing soil fertility. Further than, the lack of genetically modified cultivars and the reducing of the use of chemical fertilizers. In spite of these spe-

cifics which are regarded as essential for approving organic culture, but any farm or field of organic culture has not been registered yet in the Region. The most important reason behind that might be due to the absence of a formal approved organization able to issue the required certifications to regard such farms as organic culture farms.

The ministry of Agriculture is working hard to improve organic culture by applying many attempts to achieve training courses for the Agricultural staff like:

- a. Participating of a number of employees abroad of Iraq in order to benefit from the foreign experience in this category. Where three of the Agricultural ministry employees participated in a training course in Australia about IPM. As well as, another number of employees in a training course about compost preparation in Australia.
- b. Two of the employees applied two field illustrations for the production and use of compost by participating of about 30 farmers in each. These sessions were applied by the program of reactivation of Agricultural extension in Iraq (IAER) sponsored by the American Universities including the University of Texas A and M.
- c. It is proposed to send the employees to CIHEAM institution in Bari \_ Italy to participate in an IPM training session.
- d. Exporting organic pomegranate (produced from organic orchards in Halabja, Suleiman city) to Dubai/UAE through INMA/USAID.

COMPOST has been prepared by some of research centers in Kurdistan Region of IRAQ in which 45 tons of the COMPOST has been prepared by local methods to be used in agricultural researches. We suggest the followings:

- a. Preparation of specific training sessions for Agricultural extension employees in the ministry of Agriculture and for the teaching staff of Agricultural Colleges in the Region in order to prepare well-practiced persons (TOT) in Organic culture.
- b. Applying extension training courses for farmers to introduce them with organic culture and it's economic and healthy advantages.

- c. Including the course of organic culture into the approached courses of agriculture Institutions and Colleges.
  - d. Establishing internationally dependent bureaus and companies for investigating and issuing specific certificates for organic culture according to international standards.
  - e. Preparation of a complete plan for organic culture in both scientific research centers and Agricultural Colleges.
  - f. Contacting specific organizations of organic culture all over the world for coordination and benefiting from their experience in this category.
4. 2001 FDA Food Code: <http://vm.cfsan.fda.gov/~dms/fc01-toc.html>
  5. Center for Disease Control and Prevention: <http://www.cdc.gov/>
  6. Foodborne Illness statistics: [http://www.cdc.gov/epo/mmwr/mmwr\\_ss.html](http://www.cdc.gov/epo/mmwr/mmwr_ss.html)
  7. Pathogens fact sheet: <http://www.cdc.gov/ncidod.diseases/diseases.htm>
  8. Center for Food Safety and Applied Nutrition: <http://vm.cfsan.fda.gov/list.html>
  9. Current Good Manufacturing Practices (GMPs) regulations 21 CFR 100-169: <http://cm.cfsan.fda.gov/~lrd/part110t.txt>
  10. Environmental Protection Agency: [www.epa.gov](http://www.epa.gov)
  11. FDA Juice HACCP Regulations (January 19, 2001): <http://www.foodsafety.gov/~dms/fs-toc.html#juice>
  12. EUREPGAP: [http://www.eurep.org/sites/index\\_e.html](http://www.eurep.org/sites/index_e.html)
  13. Academic journal papers reference list: <http://www.cfsan.fda.gov/~comm/ift3refs.html>
  14. Cornell Good Agricultural Practices Project: <http://www.gaps.cornell.edu/>
  15. Food Safety Consortium at Iowa State University: <http://www.foodsafety.iastate.edu>
  16. FAO:GAP: [www.fao.org/prods/GAP/index\\_en.htm](http://www.fao.org/prods/GAP/index_en.htm)
  17. [www.slideshare.net/dduchar/good-agricultural-practices-d-ducharme](http://www.slideshare.net/dduchar/good-agricultural-practices-d-ducharme)

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2. International Association of Food Protection: <http://www.foodprotection.org>
3. University of California – Davis: Vegetable Research Information Center: <http://vric.ucdavis.edu/>