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Weeds Management in the Agriculture Plants and Crops

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CHAPTER 3
BOOK: INSECT PESTS, DISEASES AND WEEDS MANAGEMENT

WEEDS MANAGEMENT IN THE AGRICULTURE PLANTS AND CROPS

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Subtitle: Prescription: A Handbook for Agriculturist

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Abstract

This chapter mainly informed about the management of the weeds of different grain crops, vegetables, flower crops, oil crops, and others. The weeds were very damaging to main product the quality crops/fruits and this paper study on the inform about weed and how to management the weeds in field. Here is also focus on the common crops and their weeds and common name, scientific name and also added the herbicide name to manage weeds in different plants. The farmers used balance fertilizer and also used chemical insecticides to minimize crop damage. It has been estimated that of the average at 36.5% of total losses where 6.2% by weeds. This chapter has efforted the prescription to the weed management in farmer fields. Hence, I think if this book is available for all agriculturists and farmers then they will benefit.

Keywords: Weeds, plants, grain crops, vegetables, flower crops, oil crops

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DEFINITION OF WEED

Weeds are plants that are unwanted in a very given scenario and will be harmful, dangerous or economically damaging. Weeds are a significant threat to primary production and diversity. They reduce farm and forest productivity, displace native species and contribute considerable to land and water degradation. The costs of weeds to the natural environment are also high, with weed invasion being hierarchal second solely to environs loss in inflicting diversity decline.

WEED IDENTIFICATION

Dicotyledons (most broad-leaf weeds) and monocotyledons (e.g. grasses) are the two main plant types. Weed grouping has a significant impact on the potential for management. The more closely related a weed is to the host crop, the harder it will be to manage. Weed and crop family groupings (monocotyledons - 'M')

Important weeds with family and related crops

Family	**Weed examples**	**Related crops**
Apiaceae	slender celery (*Ciclospermum leptophyllum*) Australian carrot (*Daucus glochidiatus*)	celery, carrot, parsley
Amaranthaceae	amaranths (*Amaranthus* spp.)	Chinese amaranthus
Asteraceae	billygoat weed (*Ageratum* spp.) sowthistle (*Sonchus oleraceus*) cobbler's pegs (*Bidens pilosa*) fleabanes (*Conyza* spp.) parthenium (*Parthenium hysterophorus*) potato weed (*Galinsoga parviflora*)	lettuce, artichokes
Brassicaceae	wild turnip (*Brassica tournefortii*) wild radish (*Raphanus raphanistrum*) turnip weed (*Rapistrum rugosum*) shepherd's purse (*Capsella bursapastoris*) peppercress (*Lepidium* spp.) lesser swinecress (*Coronopus didymus*)	cabbage, cauliflower, broccoli, brussels sprouts, Chinese cabbage
Chenopodiaceae	fat hen (*Chenopodium* spp.)	beetroot
Convulvulaceae	bell vine (*Ipomoea plebia*) bindweed (*Convolvulus erubescens*)	sweetpotato
Euphorbiaceae	caster oil plant (*Riccinus communis*) caustic creeper (*Euphorbia drummondii*)	cassava
Fabaceae	rattlepod (*Crotalaria* spp.) vetch (*Vicia monantha*) medics (*Medicago* spp.)	peas, beans onion,
Liliaceae (M)	onion weed (*Nothoscordum gracile*)	onion, garlic
Malvaceae	small-flowered mallow (*Malva parviflora*) sida (*Sida* spp.)	okra, rosella, cotton

	bladder ketmia (*Hibiscus trionum*) anoda weed (*Anoda cristata*)	
Solanaceae	apple of Peru (*Nicandra physalodes*) nightshades (*Solanum* spp.) thornapples (*Datura* spp.)	tomato, potato, capsicum, eggplant

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METHODS OF WEED CONTROL

For designing any weed management program in a very given space, one should recognize the character and environs of the weeds in that area, how they react to environmental changes and how they respond to herbicides. Before selecting a method of weed control one, much have information on the number of viable seeds nature of dispersal of seeds, dormancy of seeds, longevity of buried seeds and ability to survive under adverse conditions, life span of the weed, soil textures moisture and (In case of soil applied volatile herbicides the herbicide will be successful only in sandy loam soil but not in clayey soil. Flooding as a method of weed control will be successful only in heavy soil and net in sandy soil) the area to be controlled.

Principles of weed control:

Here is attached the principle of weed control management procedure.

a) Prevention

b) Eradication

c) Control

d) Management

a). Preventive weed control

It encompasses all measures taken to prevent the introduction and/or establishment and spread of weeds. Such areas may be local, regional or national in size. No weed control program is successful if adequate preventive measures are not taken to reduce weed infestation. It is a long-term planning so that the weeds could be controlled or managed more effectively and economically than is possible where these are allowed to disperse freely.

Weed free seeds crop

It may be produced by following the pre-cautionary measures.

1. Separating crop seeds from admixture of crop and weed seeds using physical differences like size, shape, color, weight / texture and electrical properties.
2. Using air-screen cleaners and specific gravity separators, which differentiate seeds based on

seed size, shape, surface area and specific gravity.

3. Through means of Seed certification, we can get certified seeds and can be used safely because the certified seeds contain no contaminant weed seeds

4. Weed laws are helpful in reducing the spread of weed species and in the use of well adapted high quality seeds. They help in protecting the farmers from using mislabeled or contaminated seed and legally prohibiting seeds of noxious weeds from entering the country.
5. Quarantine laws enforce isolation of an area in which a severe weed has become established and prevent the movement of the weed into an uninfected area.
6. Use of pre-emergence herbicides also helpful in prevention because herbicides will not allow the germination of weeds.

b). Eradication:

It infers that a given weed species, its seed and vegetative part has been killed or completely removed from a given area and that weed will not reappear unless reintroduced to the area. Because of its difficulty and high cost, eradication is usually attempted only in smaller areas such as few hectares or few thousand m2 or less. Eradication is often used in high value areas such as green houses, ornamental plant beds and containers. This may be desirable and economical when the weed species is extremely noxious and persistent as to make cropping difficult and economical.

c). Control

It encompasses those processes where by weed infestations are reduced but not necessarily eliminated. It is a matter of degree ranging from poor to excellent. In control methods, the weeds are seldom killed but their growth is severely restricted, the crop makes a normal yield. In general, the degree of weed control obtained is dependent on the characters of weeds involved and the effectiveness of the control method used.

d). Weed management

Weed control aims at only putting down the weeds present by some kind of physical or chemical means while weed management is a system approach whereby whole land use planning is done in advance to minimize the very invasion of weeds in aggressive forms and give crop plants a strongly competitive advantage over the weeds. Weed control methods are grouped into cultural, physical, chemical and biological. Every method of weed control has its own advantages and disadvantages. No single method is successful under all weed situations. Many a time, a combination of these methods gives effective and economic control than a single method.

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MECHANICAL WEED CONTROL

Mechanical or physical methods of weed control are being employed ever since man began to grow crops. The mechanical methods include tillage, hoeing, hand weeding, digging cheeling, sickling, mowing, burning, flooding, mulching etc.

a). Tillage

Tillage removes weeds from the soil resulting in their death. It may weaken plants through injury of root and stem pruning, reducing their competitiveness or regenerative capacity. Tillage also buries weeds. Tillage operation includes ploughing, discing, harrowing and leveling which is used to promote the germination of weeds through soil turnover and exposure of seeds to sunlight, which can be destroyed effectively later. In case of perennials, both top and underground growth is injured and destroyed by tillage.

b). Hoeing

Hoe has been the most appropriate and widely used weeding tool for centuries. It is however, still a very useful implement to obtain results effectively and cheaply. It supplements the cultivator in row crops. Hoeing is particularly more effective on annuals and biennials as weed growth can be completely destroyed. In case of perennials, it destroyed the top growth with little effect on underground plant parts resulting in re-growth.

c). Hand weeding

It is done by physical removal or pulling out of weeds by hand or removal by implements called khurpi, which resembles sickle. It is probably the oldest method of controlling weeds and it is still a practical and efficient method of eliminating weeds in cropped and non-cropped lands. It is very effective against annuals, biennials and controls only upper portions of perennials.

d). Digging

Digging is very useful in the case of perennial weeds to remove the underground propagating parts of weeds from the deeper layer of the soil.

e). Sickling and mowing

Sickling is also done by hand with the help of sickle to remove the top growth of weeds to prevent seed production and to starve the underground parts. It is popular in sloppy areas where only the

tall weed growth is sickled leaving the root system to hold the soil in place to prevent soil erosion. **Mowing** is a machine-operated practice mostly done on roadsides and in lawns.

f). Burning

Burning or fire is often an economical and practical means of controlling weeds. It is used to (a) dispose of vegetation (b) destroy dry tops of weeds that have matured (c) kill green weed growth in situations where cultivations and other common methods are impracticable**.**

g). Flooding

Flooding is successful against weed species sensitive to longer periods of submergence in water. Flooding kills plants by reducing oxygen availability for plant growth. The success of flooding depends upon complete submergence of weeds for longer periods.

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CULTURAL WEED CONTROL

Several cultural practices like tillage, planting, fertilizer application, irrigation etc., are employed for creating favorable condition for the crop. These practices if used properly, help in controlling weeds. Cultural methods, alone cannot control weeds, but help in reducing weed population. They should, therefore, be used in combination with other methods. In cultural methods, tillage, fertilizer application. and irrigation are important. In addition, aspects like selection of variety, time of sowing, cropping system, cleanliness of the farm etc., are also useful in controlling weeds.

a). Field preparation

The field has to be kept weed free. Flowering of weeds should not be allowed. This helps in prevention of buildup of weed seed population.

b). Summer tillage

The practice of summer tillage or off-season tillage is one of the effective cultural methods to check the growth of perennial weed population in crop cultivation. Initial tillage before cropping should encourage clod formation. These clods, which have the weed propagules, upon drying desiccate the same. Subsequent tillage operations should break the clods into small units to further expose the shriveled weeds to the hot sun.

c). Maintenance of optimum plant population

Lack of adequate plant population is prone to heavy weed infestation, which becomes, difficult to control later. Therefore, practices like selection of proper seed, right method of sowing, adequate seed rate protection of seed from soil borne pests and diseases etc. are very important to obtain proper and uniform crop stand capable of offering competition to the weeds.

d). Crop rotation

The possibility of a certain weed species or group of species occurring is greater if the same crop is grown year after year. In many instances, crop rotation can eliminate at least reduce difficult weed problems. The obnoxious weeds like *Cyperus rotundus* can be controlled effectively by including low land rice in crop rotation.

e). Growing of intercrops

Inter cropping suppresses weeds better than sole cropping and thus provides an opportunity to utilize crops themselves as tools of weed management. Many short duration pulses viz., green gram and soybean effectively smother weeds without causing reduction in the yield of main crop.

f). Mulching

Mulch is a protective covering of material maintained on soil surface. Mulching has smothering effect on weed control by excluding light from the photosynthetic portions of a plant and thus inhibiting the top growth. It is very effective against annual weeds and some perennial weeds like *Cynodon dactylon.* Mulching is done by dry or green crop residues, plastic sheet or polythene film. To be effective the mulch should be thick enough to prevent light transmission and eliminate photosynthesis.

g). Solarisation

This is another method of utilisation of solar energy for the desiccation of weeds. In this method, the soil temperature is further raised by 5 – 10 ºC by covering a pre-soaked fallow field with thin transparent plastic sheet. The plastic sheet checks the long wave back radiation from the soil and prevents loss of energy by hindering moisture evaporation.

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CHEMICAL METHOD AS HERBICIDAL CONTROL OF WEEDS

Herbicides are chemicals capable of killing or inhibiting the growth of plants. In the last 40 years or so, man has greatly improved upon his weeding efficiency by supplementing the conventional weeding methods with herbicides. It has saved farmers of undue, repeated intercultivations and hoeing, and has helped him in obtaining satisfactory weed control where physical methods often fail. Today, we have over 1501 herbicides in common use for selective and non-selective weed control in different areas. These chemicals vary greatly in their (a) molecular structures, (b) mobility within plants, (c) selectivity, (d) fate in soils, and (e) response to environment.

Many chemicals have shown high codes of selectivity to certain crops, killing the weeds effectively. But proper selection of the herbicide, its rate, time, and method of application are very important to obtain the desire degree of weed control and crop selectivity. Herbicides are tools, and tool must be used with care. Many developing nations have made a good beginning in the use of herbicides in agriculture, but more comprehensive research needs to be done before extending it to new situations.

BENEFITS OF HERBICIDES

Herbicides were developed in the western world primarily to overcome the shortage of farm labour for weeding crops. However, during the past four decades, slowly the utility of herbicides has also been realized in the labour-rich tropical world, for varied reasons. Given adequate labour and money to remove weeds manually, still many advantages accrue from the judicious use of herbicides. Important among these are the following: -

1. In monsoon season incessant rainfall may make physical weeding infeasible. Herbicides can be used to ensure freedom of crops from weeds under such a condition. Also, during the early crop growth period when many fields need weeding simultaneously, even in labour-rich countries like India, Pakistan, Bangladesh, Nepal, Nigeria, and Sudan, there is certainly a weeding bottleneck in crop production. The soil applied herbicides can be of great help in these regions in boosting crop production.
2. Herbicides can be employed to control weeds as they emerge from the soli to eliminate weed crop interference even at a very early stage of crop growth. But by physical methods weeds are removed after they have offered considerable competition to the crops, and rarely at the critical time. Thus, herbicides provide benefits of timely weed control.

3. Herbicides can kill many weeds that survive by mimicry, for example, wildoat (*Avena* spp.) in wheat and barnyardgrass (*Echinochola* spp.) in rice. Weeds that resemble crop plants usually escape physical weeding.

4. Herbicidal control does not dictate strict row spacing's. In physical weed control, on the other hand, the crop rows have to be sufficiently wide to accommodate weeding implements, else hand weeding and hand-pulling of weeds has to be resorted to.

5. Herbicides bring about longer lasting control of perennial weeds and brushes than is possible with any physical control method. Many modern herbicides can translocate considerably deep in the underground system of weeds and damage them.

6. Herbicides are convenient to use on spiny weeds which cannot be reached manually. When cultivators or hoes are worked hard in an attempt to uproot the established weeds, they may cut many feeding roots of a crop like maize, which are appreciable in the first 10 cm depth of the soil. Their lateral growth fully occupies the inter-row spaces.

7. Herbicides are safe on erodible lands where tillage may accelerate soil and water erosion. Excessive tillage, in any case, spoils soil structure, reduces organic matter content, and depletes moisture status of the soil.

8. Herbicides kill weeds in *situ* without permitting their dissemination. Tillage on the other hand, may fragment the vegetative propagules of the weeds and drag them to new sites.

9. Herbicide sprays easily reach the weeds growing in obstructed situations, such as utility-right of way, under fruit trees, and on undulating lands.

Some other benefits of using herbicides include (a) fewer labour problems, (b) greater possibility of farm mechanization, (c) easier crop harvesting and (d) lower cost of farm produce. In dry land agriculture, effective herbicidal control ensures higher water use by crops and less crop failures due to drought.

LIMITATIONS OF HERBICIDES

Like any other method of weed control, herbicides have their own limitations. But with proper precautions these limitations can be overcome, markedly. Important limitations in the use of herbicides are as follows.

1. In herbicidal control there is no automatic signal to stop a farmer who may be applying the chemical inaccurately till he sees the results in the crops sprayed or in the rotation crops that follow.

2. Even when herbicides are applied accurately, these may interact with environment to produce un-intended results. Herbicide drifts, wash-of, and run-off can cause considerable damage to the neighbouring crops, leading to unwarranted quarrels.

3. Depending upon the diversity in farming, a variety of herbicides must be stocked on a farm to control weeds in different fields. On the contrary, for physical control of weeds a farmer has to possess only one or two kinds of weeding implements for his entire farm.

4. Above all, herbicidal control requires considerable skill on the part of the user. He must be able to identify his weeds and possess considerable knowledge about herbicides and their proper usages. Sometimes, an error in the use of herbicides can be very costly.

5. In herbicide treated soils, usually, crop failures cannot be made up by planning a different crop of choice. The selection of the replacement crop has to be based on its tolerance to the herbicide already applied.

6. Military use of herbicides is the greatest misfortune of their discovery. In Vietnam, 2,4-D and 2,4,5-T, for example, were used for defoliating forests and crops, leading to miseries to the innocent civilians. In future, the chemical warfare with residual herbicides may be even more devastating, which must be avoided at all costs.

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BIOLOGICAL CONTROL

Use of living organism's viz., insects, disease organisms, herbivorous fish, snails or even competitive plants for the control of weeds is called biological control. In biological control method, it is not possible to eradicate weeds but weed population can be reduced. This method is not useful to control all types of weeds. Introduced weeds are best targets for biological control.

Mode of action

a. Differential growth habits, competitive ability of crops and varieties prevent weed establishment Eg. Groundnut, cowpea fast growing and so good weed suppresser.

b. Insects kill the plants by exhausting plant food reserves, defoliation, boring and weakening structure of the plant.

c. Pathogenic organisms damage the host plants through enzymatic degradation of cell constituents, production of toxins, disturbance of harmone systems, obstruction in the translocation of food materials and minerals and malfunctioning of physiological processes.

Outstanding and feasible examples of biological weed control

a. Larvae of *Coctoblastis cactorum*, a moth borer, control prickly pear *Opuntia* sp. The larvae tunnel through the plants and destroy it. In India it is controlled by cochineal insects *Dactylopius indicus* and *D. tomentosus*

b. Lantana camara is controlled by larvae of C*rocidosema lantana*, a moth bores into the flower, stems, eat flowers and fruits.

c. Cuscuta spp. is controlled by M*elanagromyza cuscutae*

d. *Cyperus rotundus - Bactra verutana* a moth borer

e. *Ludiwigia parviflora* is completely denuded by *Altica cynanea* (steel blue beetle)

f. Herbivorous fish Tilapia controls algae. Common carp, a non-herbivorous fish control submersed aquatic weeds. It is apparently due to uprooting of plants while in search of food. Snails prefer submersed weeds.

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BIO-HERBICIDES/ MYCOHERBICIDES

The use of plant pathogen which are expected to kill the targeted weeds. These are native pathogen, cultured artificially and sprayed just like post-emergence herbicides each season on target weed, particularly in crop areas. Fungal pathogens of weed have been used to a larger extent than bacterial, viral or nematode pathogens, because, bacteria and virus are unable to actively penetrate the host and require natural opening or vectors to initiate disease in plants. Here the specific fungal spores or their fermentation product is sprayed against the target weed.

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WEED MANAGEMENT IN MAJOR FIELD CROPS

RICE

Seedbed: Apply any one of the Pre-emergence herbicides viz., Butachlor 2 l/ha, Thiobencarb 2/ha, Pendimethalin 2.5 l/ha, Anilofos 1.25 l/ha on 8th day after sowing to control weeds in the lowland nursery. Keep a thin film of water and allow it to disappear. Avoid drainage of water. This will control germinating weeds.

Transplanted Pre-emergence

a) Use Butachlor 2.5 l/ha or Thiobencarb 2.5 l/ha or Fluchoralin 2 l/ha or Pendimethalin 3 l/ha or Anilofos 1.25 l/ha as pre-emergence application. Alternatively, pre-emergence application of herbicide mixture viz., Butachlor 1.2 l + 2,4-DEE 1.5 l/ha or Thiobencarb 1.2 l + 2,4-DEE 1.5 l/ha or Fluchoralin 1.0 l + 2,4-DEE 1.5 l/ha or Pendimethalin 1.5 l + 2,4-DEE 1.5 l/ha or Anilofos + 2,4-DEE ready mix at 1.25 l/ha followed by one hand weeding on 30-35 days after transplanting will have a broad spectrum of weed control in transplanted rice.

b) Any herbicide has to be mixed with 50 kg of sand on the day of application (3-4 days after transplanting) and applied uniformly to the field in 2.5 cm depth of water. Water should not be drained for 2 days from the field or fresh irrigation should not be given.

c) Wherever there is possibility of heavy weed infestation, herbicides can also be applied with neem coated urea which could serve as carrier, three to four days after transplanting instead basal application of N at last puddling.

Post-emergence

If pre-emergence herbicides are not used, hand weed on 15th day after transplanting. 2,4-D sodium salt (Fernoxone 80% WP) 1250 g dissolved in 625 l/ha of water is sprayed with a high-volume sprayer, three weeks after transplanting or when the weeds are in 3-4 leaf stage.

Late hand weeding

Hand weed a second time, 80-85 days after transplanting, if necessary.

Wet seeded rice

In wet seeded rice apply Thiobencarb at 2.5 l/ha or Pretilachlor 0.9 l/ha on 4DAS/6DAS/8DAS followed by one hand weeding for effecrtive control of weeds OR Preemergence application of

Pretilachlor + safener at 0.6 l/ha on 4DAS followed by one hand weeding on 40 DAS effectively control weeds.

Rainfed rice

1. First weeding should be done between 15th and 20th day and second weeding may be done 45 days after first weeding. Or 2. Use Thiobencarb 2.5 l/ha or Pendimethalin 3 l/ha 8 days after sowing if adequate moisture is available, followed by one hand weeding on 30 to 35 days after sowing.

Direct seeded rice

Thiobencarb/Butachlor at 2.5 l/ha as pre-emergence application one day after wetting/soaking can be applied and it should be followed by hand weeding on 30th day. Sufficient soil moisture should be available for herbicidal use

Semi dry rice

Use Thiobencarb 3 l/ha or Pendimethalin 4 l/ha on 8th day after sowing as sand mix if adequate moisture is available, followed by one hand weeding on 30-35 days after sowing. Or Pre-emergence application of pretilachlor 0.6 l/ha followed by post emergence application of 2,4-D Na salt 1.25 kg/ha + one hand weeding on 45DAS.

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MAIZE

1. Apply the pre-emergence herbicide Atrazine 50 at 500 g/ha (900 lit of water), 3 days after sowing as spray on the soil surface using Back-pack/Knapsack/Rocker sprayer fitted with flat fan or deflector type nozzle followed by one hand weeding 40-45 days after sowing. For maize + Soybean intercropping system, apply pre-emergence Alachlor at 4.0 l/ha or Pendimethalin 3.3 l/ha on 3rd after sowing as spray.
2. Apply herbicide when there is sufficient moisture in the soil
3. Do not disturb the soil after the herbicide application
4. Hoe and Hand weed on 17th or 18th day of sowing if herbicide is not applied.

Note: If pulse crop is to be raised as intercrop, do not use Atrazine.

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WHEAT

1. Spray Isoproturon 800 g/ha as pre-emergence spraying 3 days after sowing followed by on hand weeding on 35th day after sowing.

2. If herbicide is not applied, give two hand weeding on 20th and 35th day after sowing.

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SOYBEAN

1. Fluchloralin may be applied to the irrigated crop at 2.0 l/ha or Pendimethalin 3.3 l/ha after sowing followed by one hand weeding 30 days after sowing.

2. If herbicide is not used, give two hand weeding on 20 and 35 days after sowing.

3. Pre-emergence application of Fluchloralin at 2.0 l/ha or Alachlor 4.0 l/ha may be used in soybean wherever labour availability for timely weeding is restricted.

SOYBEAN - RAINFED

1. If sufficient moisture is available, spray Fluchloralin at 2.0 l/ha as pre-emergence within 3 days after sowing.

2. If herbicide is not given, give two hand weeding on 20 and 35 days after sowing.

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GROUNDNUT

1. Pre-sowing: Fluchloralin at 2.0 l/ha may be applied and incorporated.

2. Pre-emergence: Fluchloralin 2.0 l/ha applied through flat fan nozzle with 900 lit of water/ha followed by irrigation. After 35-40 days one hand weeding may be given.

3. Pre-emergence application of metolachlor (2.0 l/ha) plus one hand weeding on 30 days after sowing is more profitable.

4. In case no herbicide is applied two hand hoeing and weeding are given 20th and 40th day after sowing.

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SUNFLOWER

1. Apply Fluchloralin at 2.0 l/ha before sowing and incorporate or apply as pre-emergence spray on 3 days after sowing followed by irrigation or apply Pendimethalin (3.0 l/ha) as preemergence

spray on 3 days after sowing. The spray of these herbicides has to be accomplished with Back-pack/Knapsack/Rocker sprayer fitted with flat fan nozzle using 900 lit of water/ha as spray fluid. All the herbicide application is to be followed by one late hand weeding 30-35 days after sowing

2. Hoe and hand weed on the 15th and 30th day of sowing and remove the weeds. Allow the weeds to dry for 2-3 days in the case of irrigated crop and then give irrigation.

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COTTON

1. Apply pre-emergence herbicides Fluchloralin 2.2 l/ha or Pendimethalin 3.3 l/ha three days after sowing, using a hand operated sprayer fitted with deflecting or fan type nozzle. Sufficient moisture should be present in the soil at the time of herbicide application or irrigate immediately after application. Then hand weed on 35-40 days after sowing.

Note: Do not use Diuron (Karmex) in sandy soil. Heavy rains after application of Karmex may adversely affect germination of cotton seeds.

2. Hoe and hand weed between 18th to 20th day of sowing, if herbicide is not applied at the time of sowing followed by second hand weeding on 35 to 45 DAS.

RAINFED COTTON

1. Application of Fluchloralin 2.0 l/ha or Pendimethalin 3.3 l/ha or Thiobencarb 3.0 l/ha followed by hand weeding 40 days after crop emergence. At the time of herbicide application sufficient soil moisture must be there. Fluchloralin needs soil incorporation.

2. If sufficient soil moisture is not available for applying herbicides hand weeding may be given at 15-20 days after crop emergence.

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SUGARCANE–SOLE CROP

1. Spray Atrazine 2 kg or Oxyfluurofen 750 ml/ha mixed in 900 lit of water as pre-emergence herbicide on 3rd day of planting, using deflector or fan type nozzle.

2. If pre-emergence spray is not carried out, go for post-emergence spray of gramaxone 2.5lit + 2,4-d sodium salt 2.5 kg/ha in 900 lit of water on 21st day of planting or apply 10% Ammonium sulphate on 45th, 75th and 105th day after planting as directed spray.

3. If the parasitic weed Striga is a problem, Post-emergence application of 2,4-D sodium salt 1.75 kg/ha in 650 lit of water/ha has to be sprayed. 2,4-D spraying should be avoided when neighbouring crop is cotton or bhendi or apply 20% urea for the control of Striga as directed spray.

4. If herbicide is not applied work the Junior-hoe along the ridges 25, 55, and 85 days after planting for removal of weeds and proper stirring. Remove the weeds along the furrows with hand hoe.

SUGARCANE - INTERCROP

Pre-emergence application of Thiobencarb 2.5 l/ha under cropping system in sugarcane with soybean, black gram or ground nut gives effective weed control. Raising intercrops is not found to affect the cane yield and quality.

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TOBACCO

First hand weeding taken up three weeks after planting. A spade digging is followed on 45 DAT which makes the ridges flat and then reformed one week later to have good weed control.

Control of Orobanche

Remove as and when the shoot appears above the ground level before flowering and seed set. The removed shoots are to be buried or burnt. Trap cropping of green gram or gingelly or sorghum reduces the infestation.

Chemical weed control of Orobanche

Pre-emergence application of Fluchloralin at 1.0 lit/ha or Oxyfluorfen at 0.5 lit/ha one week prior to planting controls most of the weeds.

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WEED MANAGEMENT IN HORTICULTURAL CROPS

Traditional vegetable-growing areas are usually situated adjacent to waterways, flood plains, river deltas, marsh zones, and, if herbicides are used, their environmental impact and usage conditions must be taken into account. Another aspect related to the complexity of herbicide use is its soil persistence that can seriously affect the next crops in the rotation as a result of soil residues or carryover. Vegetable rotations are very fast and intensive in many places, and herbicide toxicity can affect the next crop if the cycle of the previous crop is short enough.

We have to consider all these aspects, as well as consumer concerns on the probable presence of pesticide residues in fruit, leaves and roots of these crops and the strict limitations for marketing and export that can invalidate the hard labour and endurance of many workers. Therefore, a careful use of herbicide is compulsory, and good field practices must be followed, especially when recognition of a labelled production is desired. There is a great interest in the integration of tilling practices with chemical control because of the reduction of the herbicide impact and the cost of hand-labor.

SEED BEDS

Many vegetables are grown in seed beds to develop suitable seedlings for transplanting in the field. Soils dedicated to seed beds are usually light, with good tilth, and fertilized to obtain a good plant emergence. Seed beds are usually flood-irrigated and plastic-protected. Here we add some possibilities for weed management.

STALE SEED BEDS

Stale (‘false’) seed beds are sometimes used for vegetables when other selective weed control practices are limited or unavailable. Basically, this technique consists of the following:

1. Preparation of a seedbed 2-3 weeks before planting to achieve maximum weed-seed germination near the soil surface.
2. Planting the crop with minimum soil disturbance to avoid exposing new weed seed to favorable germination conditions.
3. Treating the field with a non-residual herbicide to kill all germinated weeds just before or after planting, but before crop emergence.

SOLARIZATION

Soil solarization is a broad-spectrum control method, simple, economically feasible and environmentally friendly. It is an effective method for the control of many weeds. It does not affect soil properties and usually produces higher yields. There are also some disadvantages in its implementation. For example, previous irrigation is a requirement, (or frequent and abundant rain) and the soil must be kept solarized (non-producing) for a period of at least one month. Results are often variable, depending on weather conditions. Cold (high latitude) or cloudy places are usually not suitable for implementing solarization. Some species can tolerate solarization (e.g. deep rooted perennials: *Sorghum halepense, Cyperus rotundus, Equisetum* spp. and also some big weed seeds such as legumes).

The soil must be clean, surface-levelled and wet, previously to being covered with a thin (0,1-0,2 mm) transparent plastic sheet and very well sealed. The soil must be kept covered during the warmer and sunnier months (30-45 days). Soil temperatures must reach above 40° C to exert a good effect on weed seeds.

After solarization the plastic must be recovered, and the use of deep or mould board tillage must be avoided. This system is more suitable for small areas of vegetables, but it has been mechanized for extensive areas of tomatoes. Soil solarization is widely used under plastic greenhouse conditions.

CHEMICAL CONTROL IN SEED BEDS

There are even less registered herbicides for seed beds than for planting crops. Herbicide treatments under plastic cover are always hazardous and careful application should be carried out. Under plastic, high levels of moisture and elevated temperature are common and plants grow very gently. Selectivity could be easily lost and phytotoxicity symptoms may occur, while sometimes they are just temporary. The effects are often erratic. The best way to deal with it is to be prudent and make some trials before a general treatment.

Selective pre-emergence and early post-emergence herbicides for vegetable seedbeds

a) Pre-emergence		
Herbicide	**Dose (kg a.i./ ha)**	Crop
Clomazone	0.18 - 0.27	Pepper, cucumber
Metribuzin	0.15 - 0.5	Tomato
Napropamide	1.0 - 2.0	Tomato, pepper, eggplant
DCPA	6.0 - 7.5	Onion, cole crops, lettuce
Pendimethalin	1.0 - 1.6, 1.0 - 2.5	
Propachlor	5.2 - 6.5	Onion, cole crops
b) Post-emergence (crops with at least 3 leaves)		
Clomazone	0.27 -0.36	Pepper
Ioxinil	0.36	Onion, garlic, leek
Linuron	0.5 - 1.0	Asparagus, carrots
Metribuzin	0.075 - 0.150	Tomato
Oxifluorfen	0.18 - 0.24	Onion, garlic
Rimsulfuron	0.0075 -0.015	Tomato

Management of weed in vegetable crops

Herbicide	Dose kg a.i./ha	Treatment moment	Crops
Alachlor	2.4	Post emergence	Brassica crops, onion
Ethalfluralin	0.8-1.7	Pre-Plantation	Tomato, pepper, beans, squash
Linuron	.50-1.25	Pre emergence	Carrot, artichoke, asparagus, faba bean
Metribuzin	0.10-0.35	Pre/Post emergence	tomato, carrots, peas
Oxifluorfen	0.36-0.48	Pre/Post emergence	Onion, garlic, cole crops
Oxifluorfen	0.24-0.48	Pre-Plantation	Tomato, pepper
Pendimethalin	1.32-1.65	Pre-Plantation/preplant	Artichoke, cole, lettuce, leek, pepper, tomato, onion, green peas
Rimsulfuron	7.5-15(g)	Post emergence	Tomato
Trifluralin	0.59-1.44	pre-plant	Beans, carrots, celery, cole crops, artichoke, onion, pepper, tomato

Conclusions

From the above study, we can say that if these prescription chapters are with an educated farmer or an agriculturist, then they can be easily produced without any loss of crops or fruits. Not only that, the crops will be good and so I think it can be easily exported in any country.

CHAPTER 3
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