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Weed Management Technologies in Organic Agriculture

ICAR-Directorate of Weed Research
Jabalpur- 482 004 (Madhya Pradesh)
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भा.कृ.अनु.प.-खे.अनु.नि.दे.
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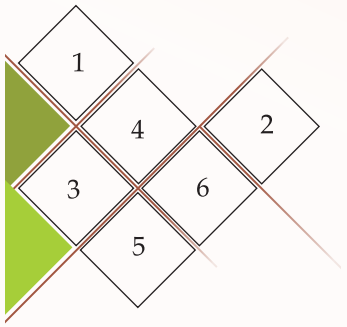
Cover photographs

1. Crop residue mulching in turmeric
2. Crop residue mulching in sweet corn
3. Paddy straw mulching in fennel
4. Horse gram intercropping in tapioca
5. Bio-degradable plastic film mulching in tea
6. Red amaranth intercropping in Guava orchard



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Message

The modern agriculture has witnessed a series of harmful effects of hazardous chemicals on the environment. Human and animal health is also affected by the industrial input based agriculture. Indiscriminate use of pesticides has created far reaching environmental problems besides creating stress to the plants. Chemical free agriculture like organic farming and natural farming, therefore, is being promoted not only in India but also in other parts of the world. Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. About 2.66 million hectare area of cropland was under organic cultivation in India as of March 2021. The Government of India has initiated various programmes such as National Programme for Organic Production (NPOP), Paramparagat Krishi Vikas Yojna (PKVY), Mission Organic Value Chain Development for North Eastern Regions (MOVCDNER), etc. to promote organic mode of food production in India. However, the productivity of organically grown crops is largely depend on the nutrient and pest management. Among the various crop pests, weeds are considered to be the most loss causing agents. When it comes to organic agriculture, weeds assume a major concern of crop management. As of now, there are no effective bio-herbicides developed in the country against weeds. Hence, they can be managed by the manipulation of agronomic practices such as stale seedbed, manual/mechanical weeding, crop rotation, intercropping, mulching, etc. The present document is a compilation of research work carried out on weed management in organically grown crops at different AICRP-Weed Management centres.

I am happy to note that the AICRP-Weed Management has come up with a publication entitled "Weed management technologies in organic agriculture" in the form of a Technical Bulletin. I congratulate the team AICRP-Weed Management in bringing out this compilation of useful information on weed management. Certainly, this bulletin shall be useful to the researchers, extension workers and other stakeholders promoting organic farming in India.

(S.K. Chaudhari)

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Foreword

Agriculture in India prior to 1960s did not depend on chemical fertilizers and pesticides. However, with the advent of Green Revolution, the new genotypes of wheat and rice were more responsive to high industrial input use. This led to a significant rise in food production in the country *vis-à-vis* application of fertilizers and pesticides. With the passage of time, the ill effects of chemical based farming have been observed in human, animals and whole environment. Not only in India but world all over, a new movement of farming based on organic inputs started which now is being practiced in small areas in almost all the countries. The government of India envisages bringing 5 million hectares under organic farming by 2025. The agriculture based on farm grown inputs without dependence on the industrial products is of many types. It may be called as organic farming or natural farming or vedic agriculture. The idea is to produce food grains and allied products without residues of harmful chemicals that pollute the environment and affect human and animal health.

It has been observed that weeds pose a greater threat in organic/natural farming as control measures are limited and restrict to traditional weeding techniques. Manual weeding has become too costly to sustain the profits due to costly labour and its availability at the crucial time of weed competition. Hence, it is imperative to devise practices that may reduce the infestation of weeds in organically grown crops and cropping systems. The AICRP-Weed Management has undertaken research work on weed management in organic crops and come up with economically viable technologies for organic cropping systems.

The present technical bulletin "Weed management technologies in organic agriculture" is a compilation of the practices developed for weed management in organic crops at different centres of AICRP-Weed Management. I congratulate the editors for bringing out this publication and all the scientists for contribution to such knowledge. I am sure that this bulletin would be helpful for farmers, researchers and other stakeholders.

(S. Bhaskar)

Preface

Alternate agri-systems like conservation agriculture, organic farming and natural farming are being advocated to mitigate the problems arising due to climate change, soil degradation, pesticide residues in food products etc. and to enhance climate resilience and sustainability of food production systems. Organic farming is more relevant for small and marginal farmers of the country as they are resource-poor to provide costly inputs for enhancing productivity. Government of India has been promoting organic/natural farming through dedicated schemes namely *Paramparagat Krishi Vikas Yojana* (PKVY), Mission Organic Value Chain Development in North East Region (MOVCDNER), *Rashtriya Krishi Vikas Yojana* (RKVY), Mission for Integrated Development of Horticulture (MIDH), National Food Security Mission (NFSM) and Network Project on Organic Farming under Indian Council of Agricultural Research (ICAR). At present, about 2.7 million ha area is under organic cultivation in India.

Among various production technologies, efficient nutrient and pest management play major role in organic system. Weeds are one of the major constraints in sustaining the productivity of organically grown crops. In absence of synthetic herbicides, organic farmers mostly rely on cultural and mechanical practices to manage weeds. Preventive measures like weed-seed free crop seeds and organic manures (FYM, compost, etc.), preventing weed spread though irrigation water, animal and human movement, removal of weeds before flowering and seed-setting can be helpful in reducing weed problems in organic agriculture. Cultural practices like stale seedbed, crop diversification and intercropping, mulching, soil solarization, etc. are helpful in reducing the weed infestation. Hand pulling and mechanical weeding using different tools and implements are also practiced for management of weeds in organic farms.

The ICAR-Directorate of Weed Research (DWR) and the All India Coordinated Research Project on Weed Management (AICRP-WM) undertook a programme on weed management in organic agriculture during the past 4-5 years. This technical bulletin contains the technologies developed in weed management in organically grown crops. The contribution of the scientists at AICRP-WM and ICAR-DWR in generating this valuable information is duly acknowledged. Valuable feedback on the technologies mentioned in this bulletin shall further help in improving the research programme on weed management in organic agriculture.

R.P. Dubey
J.S. Mishra

Contents

Organic agriculture and weed management - an overview

Organic agriculture is a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved (IFOAM, 2008). It is an alternative system to conventional agriculture to reduce the over-reliance on chemical fertilizers and industrial pesticides, and to make the agriculture more sustainable. The chemical based agriculture has limitations of developing health hazards in the agro-ecosystem as well as resistance in pests to pesticides. The total area under organic agriculture in world during 2020 was 74.9 million hectares, the maximum being in Oceania (48% i.e. 35.9 m ha). India with 2.66 m ha land area under organic agriculture, ranks 4th in the world (Figure 1)

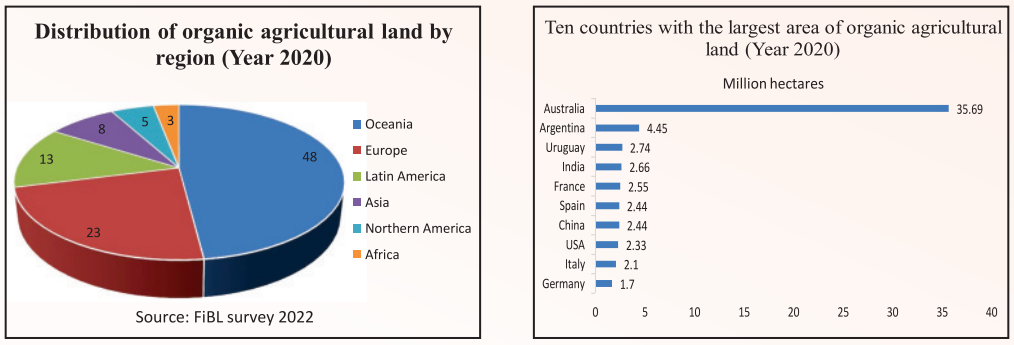

Figure 1. Distribution and area under organic agriculture in the world (Source: FiBL survey 2022)

In India, concept of organic farming is not new, the agriculture was practiced based on farm grown inputs only. The green revolution happened in late sixties which led to self-sufficiency in food production but indiscriminate use of agro-chemicals has started showing its ill effects on food-chain and environment. To overcome these problems, it is being realized to include organic agriculture supported by scientific research and modern inputs.

The total area under organic certification process (registered under National Programme for Organic Production) was 4339184.93 ha (2020-21). This includes 2657889.33 ha cultivable area and another 1681295.61 ha for wild harvest collection (APEDA, 2022). Among all the states, Madhya Pradesh has covered the largest area under organic certification followed by Rajasthan, Maharashtra, Chhattisgarh, Himachal Pradesh, Jammu & Kashmir and Karnataka. India produced around 3496800.34 MT (2020-21) of certified organic products which includes all varieties of food products. The total volume of export during 2020-21 was 888179.68 MT. The organic food export realization was around INR 707849.52 Lakhs (1040.95 million USD).

Weeds are one of the major biotic factors causing significant loss in productivity of different agro-ecosystems by competing with crops for different resources. In field crops,

the loss caused due to weeds has a wide range of 15-90%, although it largely depends on the management strategies adopted. Of the total loss caused by various pests in agriculture, weeds accounts for 37% followed by insects (29%), diseases (22%) and others including nematodes, rodents, mites, birds, etc. (12%). Most of the crops during their early stage of growth are slow-growing. Weed seeds germinate along with crop seeds or many a times even before, and start competing with crops for vital growth resources (moisture, nutrients and solar radiation) resulting in severe yield loss. In addition, weeds also act as an alternative host of insects and pathogens, deteriorate the quality of produce, and reduce the input-use efficiency. Based on the study conducted at the ICAR-Directorate of Weed Research, Jabalpur from 1581 On-farm trials conducted in different agro-ecological regions of the country, the actual yield loss due to weeds was estimated to be 14% in transplanted rice to as high as 36% in groundnut (Gharde *et al*., 2018). All together total actual economic loss due to weeds in 16 major crops was estimated as Rs 78,591 crores per annum(Fig 2). However, the total economic losses will be much higher, if all the crops, and indirect effects of weeds on human and animal health, loss of biodiversity, nutrient depletion, reduction in grain quality, etc. are taken into consideration.

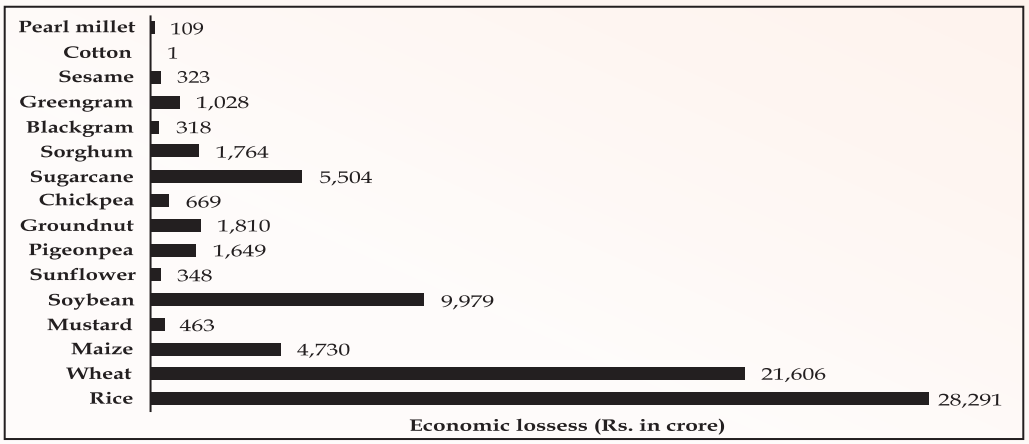

Figure 2. Economic loss due to weeds in different crops in India (Gharde *et al*., 2018)

In organic crop production system, weeds are one of the most serious challenges. Apart from insect-pests and diseases, major yield losses in organic production systems are caused by weeds. Ineffective control of weeds is one of the major impediments in a large-scale adoption of organic farming (Beveridge and Naylor, 1999). Less emphasis has been given to weed management-related issues in organic farming. So far, the major focus has been on the manual and mechanical methods of weed management in organically grown crops, by designing different types of weeding tools and implements. This conventional and narrow approach neglects the holistic nature of organic agriculture, and underestimated the design of real, effective organic crop production systems (Andrews *et al*., 1990; Lockeretz, 2000).

While approaching for effective weed management in organic system, it is vital to reduce soil weed seedbank and crop-weed competition below threshold levels. Weed management practices should be developed in such a way that they should reduce

competition from current and future weeds by preventing the weed seed production and vegetative propagules, improve crop yields and income, and reduce the cost of production. Organic weed management involves careful planning of the cropping system to minimize weed problems, and seeks to utilize biological and ecological processes to give crops an advantage over weeds. Therefore, a too narrow view of weed management underestimates the interaction effects among system components and of their carryover effects in subsequent seasons, and may have little impact on overall weed control.

The long-term use of herbicides has resulted in the development of herbicide resistance in the weeds. Large scale resistance to herbicides in *Phalaris minor* in Punjab and Haryana has been troubling farmers and researchers. Synthetic herbicides, defoliants and desiccants are not permitted in organic systems. Unlike herbicide use in conventional farming, weed management in organic agriculture mainly relies on management techniques, both cultural and mechanical, developed to prevent infestation of weeds along with growing a vigorous crop which is able to compete with the weeds. The weed control strategies for organic crops are based on the principles of prevention, tillage, stale seedbed, crop rotation, competitive crops and varieties, intercropping, planting geometry, mulches, smoother crops, soil solarization, nutrient and water management, efficient weeding tools and machinery, biological weed control etc. Therefore, integrated weed management (IWM) approach involving 'many little hammers' concept and 'use of technological advancement' is needed. Mechanical weeding and weed seed destruction techniques are the major components for designing effective weed management programme for organic agriculture.

The AICRP-Weed Management took up a research programme on weed management in organic crops and cropping systems during 2014 involving its 17 coordinating centres under that many states. The experiments involved developing package of practices of weed management in organically grown crops and cropping systems of the respective states.This technical bulletin exemplifies the integrated weed management practices developed by the ICAR-Directorate of Weed Research and its cooperating centres in different crops and cropping systems.

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Weed management technologies in organic agriculture

Assam

Chilli

1. Weed flora

Ageratum houstonianum, Commelina diffusa, Cuphea balsamona, Ludwigia linifolia, Mimosa pudica, Scoparia dulcis, Spermacoce hispida, Cynodon dactylon, Digitaria setigera, Eleusine indica, Panicum repens, Cyperus rotundus and *Kyllingia brevifolia.*

2. Technology

Mulch the chilli crop with rice straw at 5 t/ha quantity *fb* one need based hand weeding. All other recommended package of practices are followed to grow the crop organically.

3. Crop yield

The highest chilli fruit yield of 5.76 t/ha could be obtained with this technology.

4. Economics

a. Cost of weed management: Rs 10000/ha

b. BC ratio: 2.56

Chilli crop mulched with rice straw (5 t/ha)

Assam

Tea

1. Weed flora

Chromolaena odorata, Mikania micrantha, Scoparia dulcis, Spermacoce spp., *Axonopus compressus, Digitaria setigera, Ischaemum* sp., and *Oplismenus burmannii.*

2. Technology

Mulch the interspaces within tea bushes with bio-degradable plastic film. All other recommended package of practices are followed to grow the crop organically.

3. Crop yield

The highest tea leaf yield of 6.69 t/ha could be obtained.

4. Economics

a. Cost of weed management: Rs 15000/ha

b. BC ratio: 1.36

Bio-degradable plastic film mulch in tea plantation

Chhatttisgarh

Aromatic rice – sweet corn cropping system

1. **Weed flora**

   Rice: *Alternanthera triandra, Celosia argentea, Echinochloa colona, Cyperus iria, Spilanthes acmella, S. diander, Cynotis axillaris, Ischaemum rugosum* and *Fimbristylis miliacea.*

   Sweet corn: *Medicago denticulata, Chenopodium album, Echinochloa colona, Alternanthera triandra, Physalis minima, Cassia tora* and *Cannabis sativa.*

2. **Technology**

   In *Kharif* transplanted rice: Motorized weeder (single row type) + one intra row hand weeding at 25 and 35 days after transplanting (DAT).

   In Sweet corn: Black polythene (25µ) mulch.

   50% N (FYM) + 50% N (Poultry manure)+ PSB + *Azospirillum* in rice, and 50% N (FYM) + 50% N (poultry manure) in sweet corn for supplying nutrients.

3. **Crop yield**

   Rice – 2.53 t/ha; Sweet corn – 5.62 t/ha

4. **Economics**

   a. Total cost of cultivation: Rice (Rs 34200/ ha) and Sweet corn (Rs 45000/ha)

   b. Cost of weed management: Rice (Rs 5000/ ha) and Sweet corn (Rs 12000/ha)

   c. Net returns: Rice (Rs 31580/ha) and Sweet corn (Rs 95500/ha)

   d. BC ratio: Rice (1.92) and Sweet corn (3.19)

Weed management in rice through motorized weeder

Weed management in sweet corn through plastic mulch

Gujarat

Fennel-greengram cropping system

1. Weed flora

Eleusine indica, Dactyloctenium aegyptium, Commelina benghalensis, Eragrostis major, Oldenlandia umbellata, Phyllanthus niruri, Boerhavia diffusa and *Digera arvensis.*

2. Technology

Apply farm yard manure @ 20 t/ha, transplant forty days old fennel seedlings during September as flat bed planting keeping 90 cm x 60 cm spacing. Apply paddy straw mulch at 10 t/ha one day after planting. Follow recommended package of practices to grow crop organically. The few emerged weeds out of mulch are required to be hand pulled at 30 and 60 days after sowing. Crop matures for harvesting during March. Greengram crop is grown on the residual soil fertility with one hand weeding.

3. Crop yield

Fennel seed equivalent yield of 2.94 t/ha [(fennel seed yield 2.66 t/ha and greengram 0.54 t/ha)] could be obtained. Very few weeds emerge due to soil covered by paddy straw mulch. Highly beneficial during paucity of laborer as well as compared to traditional weed management practices.

4. Economics

a. Total cost of cultivation: Rs 107589/ha

b. Cost of weed management: Rs 15340/ha

c. Net returns: Rs 223731/ha

d. BC ratio: 4.17

Paddy straw mulch in fennel crop

Greengram crop

Haryana

Turmeric

1. **Weed flora**

   Dactyloctenium aegyptium, Brachiaria reptans, Digitaria reptans, Eragrostis tenella, Trianthema monogyna and *Cyperus rotundus.*

2. **Technology**

   Apply paddy straw mulch 6 t/ha at the time of planting and if needed, give one hand weeding at 50 days after planting. All other recommended package of practices are followed to grow the crop organically.

3. **Crop yield**

   Rhizome yield – 15.0 t/ha

4. **Economics**

   a. Total cost of cultivation: Rs 98402/ha

   b. Cost of weed management: Rs 5470/ha

   c. Net returns: Rs 51598/ha

   d. BC ratio: 1.52

Unweeded turmeric crop

Paddy straw mulch at 6 t/ha in turmeric crop

Himachal Pradesh

Maize –pea cropping system

1. Weed flora

Maize: *Commelina* sp., *Galinsoga parviflora*, *Ageratum* sp., *Cyperus* sp., *Digitaria sanguinalis*, *Paspalum* sp., *Polygonum alatum*, *Phyllanthus niruri*, *Panicum dichotomiflorum*, *Bidens pilosa*, *Aeschynomene indica* and *Alternenthera philoxeroides*.

Pea: *Stellaria media*, *Phalaris minor*, *Vicia sativa*, *Tulipa asiatica* ,*Vicia hirsuta*, *Avena ludoviciana* , *Poa annua*, *Anagallis arvensis* and *Ranunculus arvensis*.

2. Technology

Inter-cropping of soybean *fb* manual weeding in maize during *Kharif*. While, during *Rabi*, rice straw mulch (5 t/ha) *fb* manual weeding in pea *fb* summer green manure crop. All other recommended package of practices are followed to grow the crop organically.

3. Crop yield

System yield (maize equivalent) – 35.5 t/ha

4. Economics (system basis)

a. Total cost of cultivation: Rs 152900/ha

b. Cost of weed management: Rs 34900/ha

c. Net returns: Rs 471300/ha

d. BC ratio: 3.04

Intercropping of soybean in maize crop

Rice straw mulch in pea crop

Jammu

Basmati rice-potato-french bean cropping system

1. **Weed flora**

   Rice: *Echinochloa* spp., *Cynodon dactylon, Alternanthera philoxeroides, Caesulia axillaris, Ammannia baccifera, Commelina benghalensis* and *Cyperus* spp.

   Potato: *P. minor, Anagalis arvensis, Rumex dentatus, Melilotus alba, R. arvensis* and *Vicia* spp.

   French bean: *Digitaria sanguinalis*, *Cynodon dactylon*, *Amaranthus viridis*, *Physalis minima*, *S. nigrum* and *Cyperus* spp.

2. **Technology**

   Mustard seed meal 2.5 t/ha application 10 days before planting/sowing *fb* 1 hand weeding at 30 DAT in basmati rice, potato and french bean. All other recommended package of practices are followed to grow the crop organically.

3. **Crop yield**

   Rice – 4.28 t/ha; potato – 25.58 t/ha; french bean – 6.56 t/ha

   System yield (rice equivalent) – 22.38 t/ha

4. **Economics (system basis)**

   a. Total cost of cultivation: Rs 364860/ha

   b. Cost of weed management: Rs 177724/ha

   c. Net returns: Rs 205825/ha

   d. BC ratio: 1.56

Mustard seed meal 2.5 t/ha application in rice, potato and french bean crops

Jammu

Basmati rice-broccoli cropping system

1. **Weed flora**

   Rice: *Echinochloa* spp., *Alternanthera philoxeroides*, *Ammannia baccifera*, *Commelina benghalensis* and *Cyperus* spp.

   Broccoli: *Medicago* spp., *Melilotus indica, Ranunculus arvensis, Anagalis arvensis, Vicia sativa, Rumex* spp., *Phalaris minor* and *Avena* spp.

2. **Technology**

   Rice: Stale seedbed + one mechanical weeding at 30 days after transplanting (DAT)

   Broccoli: Paddy straw mulch (6 t/ha) +1 hand weeding at 30 DAT

   All other recommended package of practices are followed to grow the crop organically.

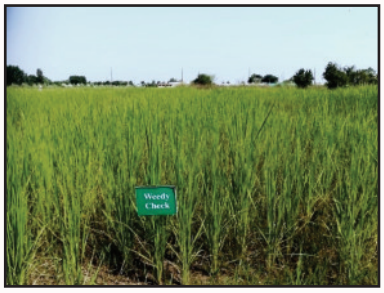
3. **Crop yield**

   Rice – 2.63 t/ha; broccoli – 9.5 t/ha

   System yield (rice equivalent) – 10.23 t/ha

4. **Economics (system basis)**

   a. Total cost of cultivation: Rs 149308/ha
   b. Cost of weed management: Rs 22850/ha
   c. Net returns: Rs 188242/ha
   d. BC ratio: 1.74



Unweeded basmati rice crop

Paddy straw mulch (6 t/ha) + 1 hand weeding in broccoli crop

Unweeded broccoli crop

Karnataka

Foxtail millet

1. Weed flora

Cyperus rotundus, Cynodon dactylon, Digitaria marginata, Echinochloa crus-galli, Echinochloa colona, Eleusine indica, Acanthospermum hispidum, Ageratum conyzoides, Boerhavia diffusa, Cleome viscosa and *Commelina benghalensis.*

2. Technology

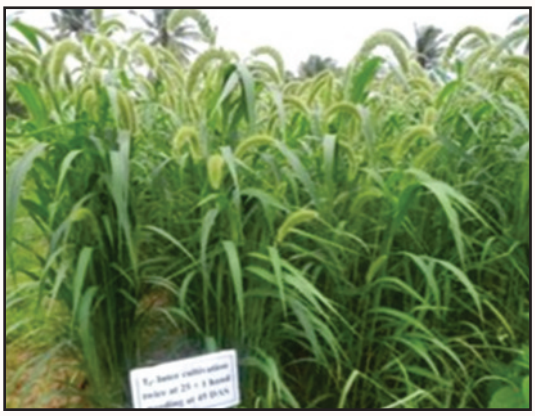
Stale seed bed treatment is initiated 20 days before sowing of the foxtail millet. One irrigation is given to allow weeds to germinate. The germinated weeds are removed by passing cultivator cris-cross, three days before sowing of the crop. The procedure is repeated 2-3 times. Thereafter, inter-cultivation is done twice at 25 & 45 DAS. All other recommended package of practices are followed to grow the crop organically.

3. Crop yield

Higher yield of 1.28 t/ha could be obtained by adopting the weed management technology of Stale seed bed technique + inter-cultivation twice at 25 & 45 days after sowing. The highest yield obtained was due to better control of weeds at tillering stage which is critical stage of crop-weed competition.

4. Economics

a. Total cost of cultivation: Rs 23975/ha
b. Cost of weed management: Rs 4450/ha
c. Net returns: Rs 19542/ha
d. BC ratio: 2.28



Inter-cultivation at 25 DAS *fb* 1 hand weeding at 45 DAS in fox tail millet crop

Kerala

Turmeric

1. Weed flora

Borreria hispida, *Alternanthera bettzickiana*, *Ludwigia perennis*, *Ageratum conyzoides*, *Cleome rutidosperma*, *Cyperus iria* and very few grass weeds.

2. Technology

Apply organic mulches like jack leaves or grass clippings or coconut coir pith @ 15 t/ha on the ridges after planting the turmeric rhizomes. Need-based hand weeding may be required to control the few emerging weeds. All other recommended package of practices are followed to grow the crop organically.

3. Crop yield

Turmeric rhizome yield from mulching with jack leaves (34.67 t/ha) or grass clippings (33.89 t/ha) or coconut coir pith (29.02 t/ha) could be obtained.

4. Economics

a. Total cost of cultivation: Rs 140000 to 155000/ha

b. Cost of weed management: Rs 40000 to 55000/ha

c. Net returns: Rs 580340 to 693460/ha

d. BC ratio: 3.92 to 4.47

Organic mulching with grass clippings and coir pith in turmeric crop

Kerala

Ginger

1. Weed flora

Alternanthera bettzickiana, Borreria hispida, Cleome spp., *Euphorbia geniculata, Mitracarpus verticillatus, Ludwigia parviflora, Lindernia crustacea, Trianthema portulacastrum, Pennisetum pedicellatum, Eleusine indica, Digitaria ciliaris, Panicum maximum* and *Cyperus rotundus.*

2. Technology

Apply organic mulch of water hyacinth @ 15 t/ha on the ridges after planting the ginger rhizomes. Need-based hand weeding may be required to control the few emerging weeds. All other recommended package of practices are followed to grow the crop organically.

3. Crop yield

The higher ginger rhizome yield of 29.88 t/ha could be obtained.

4. Economics

a. Total cost of cultivation: Rs 590000/ha

b. Cost of weed management: Rs 190000/ha

c. Net returns: Rs 1800400/ha

d. BC ratio: 4.05

Organic mulching by water hyacinth (15 t/ha) in ginger crop

Kerala

Cassava

1. Weed flora

Alternanthera bettzickiana, Borreria hispida, Cleome spp., *Euphorbia geniculata, Mitracarpus verticillatus, Ludwigia parviflora, Catharanthus pusillus, Pepperomia* sp., *Pennisetum pedicellatum, Eleusine indica, Digitaria ciliaris, Panicum maximum* and *Cyperus rotundus.*

2. Technology

Intercropping with legumes like cowpea/greengram/horsegram, followed by one earthing up at 60 days after planting (DAP). All other recommended package of practices are followed to grow the crop organically.

3. Crop yield

Legume intercropped cassava could yield ranging from 27.33 to 30.25 t/ha. The green biomass addition due to legume intercropping could be 4 t/ha in the case of cowpea, 3.2 t/ha in greengram and 3 t/ha in horsegram. Green biomass addition also results in improving soil conditions.

4. Economics

a. Total cost of cultivation: Rs 231200/ha

b. Cost of weed management: Rs 31200/ha

c. Net returns: Rs 315000 to 335000/ha

d. BC ratio: 2.36 to 2.45

Horsegram as an intercrop in cassava

Unweeded cassava crop

Kerala

Chilli

1. **Weed flora**

   Alternanthera bettzickiana, Borreria hispida, Cleome spp., *Euphorbia geniculata, Mitracarpus verticillatus, Ludwigia parviflora, Catharanthus pusillus, Pepperomia* sp., *Pennisetum pedicellatum, Eleusine indica, Digitaria ciliaris, Panicum maximum* and *Cyperus rotundus.*

2. **Technology**

   Mulch the crop with black polythene at planting. All other recommended package of practices are followed to grow the crop organically.

3. **Crop yield**

   The highest yield of 23.06 t/ha could be obtained with polythene mulching.

4. **Economics**

   a. Total cost of cultivation: Rs 445200/ha

   b. Cost of weed management: Rs 145000/ha

   c. Net returns: Rs 1844800/ha

   d. BC ratio: 4.14

Chilli crop with black polythene mulching

Unweeded chilli crop

Madhya Pradesh

Turmeric

1. **Weed flora**

   Echinochloa colona, Paspalidium flavidum, Physalis minima, Cyperus rotundus, Medicago polymorpha, Mecardonia procumbens etc.

2. **Technology**

   Apply crop residue mulch 7.5 t/ha at the time of sowing followed by need based 3 hand weedings. All other recommended package of practices are followed to grow the crop organically.

3. **Crop yield**

   Turmeric rhizome yield - 17.87 t/ha

4. **Economics**

   a. Total cost of cultivation: Rs 287948/ha

   b. Cost of weed management: Rs 61920/ha

   c. Net returns: Rs 426852/ha

   d. BC ratio: 2.48

Turmeric crop with crop residue mulch (7.5 t/ha)

Unweeded turmeric crop

Madhya Pradesh

Sweet corn

1. **Weed flora**

   Echinochloa colona, Dinebra retroflexa, Oldenlandia corymbosa, Paspalidium flavidum, Eclipta alba, Physalis minima, Cyperus rotundus and *Convolvulus arvensis.*

2. **Technology**

   Apply crop residue mulch 7.5 t/ha at the time of sowing followed by 1 hand weeding at 30 days after sowing. All other recommended package of practices are followed to grow the crop organically.

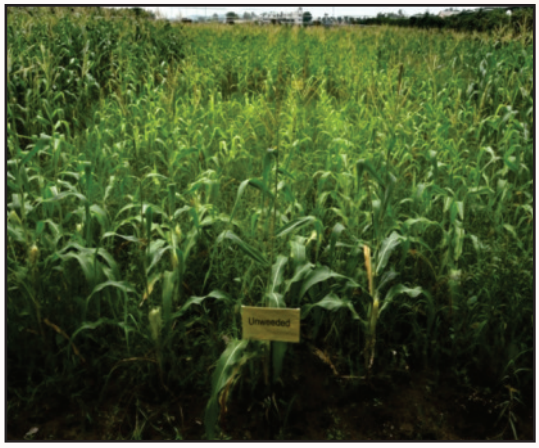
3. **Crop yield**

   Sweet corn cob yield –16.70 t/ha

4. **Economics**

   a. Total cost of cultivation: Rs 118666/ha
   b. Cost of weed management: Rs 20640/ha
   c. Net returns: Rs 215334/ha
   d. BC ratio: 2.81

Maize crop with crop residue mulch (7.5 t/ha)



Unweeded maize crop

Madhya Pradesh

Tomato

1. **Weed flora**

   Medicago denticulata, Paspalidium flavidum, Chenopodium album, Avena ludoviciana etc.

2. **Technology**

   Apply black polythene mulch before planting the tomato seedlings. Plant the seedlings in row to row distance of 60 cm and in holes made at a plant to plant spacing of 40 cm in the polythene sheet. All other recommended package of practices are followed to grow the crop organically.

3. **Crop yield**

   Tomato fruit yield - 13.40 t/ha

4. **Economics**

   a. Total cost of cultivation: Rs 72787/ha

   b. Cost of weed management: Rs 25000/ha

   c. Net returns: Rs 195613/ha

   d. BC ratio: 3.68

Black polythene mulching in tomato crop

Madhya Pradesh

Sweet corn – potato cropping system

1. **Weed flora**

   Sweet corn: *Setaria glauca, Arachne racemosa, Echinochloa crus-galli, Celosia argentea, Commelina benghalensis, Digera arvensis* and *Cyperus rotundus.*

   Potato: *Cyperus rotundus, Phalaris minor, Spergula arvensis, Polypogon monspeliensis, Chenopodium album, Medicago hispida, Anagallis arvensis* and *Convolvulus arvensis.*

2. **Technology**

   During *Kharif*, in sweet corn, intercropping with greengram is done to suppress weeds, while during *Rabi*, in potato, plastic mulch of 25 µ is laid on ridges before sowing the seed tubers. All other recommended package of practices are followed to grow the crop organically.

3. **Crop yield**

   Sweet corn cob yield of 6.39 t/ha along with green fodder yield of 10.02 t/ha and potato tuber yield of 28.25 t/ha could be obtained by following the technology.

4. **Economics**

   Sweet corn

   a. Total cost of cultivation: Rs 79367/ha
   b. Net returns: Rs 164742/ha
   c. BC ratio: 3.46

   Potato

   a. Total cost of cultivation: Rs 115600/ha
   b. Net returns: Rs 166933/ha
   c. BC ratio: 1.37

Intercropping of greengram in sweet corn

Mulching in potato with black plastic 25 µ

Odisha

Rice-tomato-okra cropping system

1. **Weed flora**

   Rice:: *Echinochloa crus-galli, Echinochloa colona, Panicum repens, Paspalum scrobiculatum, Cynodon dactylon, Marselia quadrifolia, Alternanthera sessilis, Luduwigia parviflora, Monocharia vaginalis, Cyperus difformis* and *Cyperus rotundus.*

   Tomato: *Digitaria sanguinalis, Echinochloa colona, Panicum repens, Cynodon dactylon, Chenopodium album, Amaranthus viridis, Eclipta alba, Trianthema portulacastrum, Oldenlandia corymbosa, Euphorbia hirta, Heliotropium indicum* and *Cyperus rotundus.*

   Okra: *Eleusine indica, Echinochloa colona, Sorghum halepense, Brachiaria ramosa, Cynodon dactylon, Digera arvensis, Portulaca oleracea, Tridax procumbense, Physalis minima, Cyperus difformis* and *Cyperus rotundus.*

2. **Technology**

   Apply 1/3 recommended dose of N each through FYM, *dhaincha* and neemcake with *Azospirillum* + PSB to rice followed by same proportion of organics through FYM, Vermicompost and Neem cake with *Azotobacter* + PSB to tomato and okra along with one manual weeding + one mechanical weeding in rice-tomato-okra system.

3. **Crop yield**

   Rice – 4.40 t/ha; tomato –16.53 t/ha; okra – 6.03 t/ha
   System yield (rice equivalent) – 21.45 t/ha

4. **Economics**

   a. Total cost of cultivation: Rs 164627/ha
   b. Cost of weed management: Rs 41160/ha
   c. BC ratio: 1.60

Organic rice crop

Organic tomato crop

Organic okra crop

Punjab

Turmeric

1. **Weed flora**

   Trianthema portulacastrum, Eleusine indica, Cyperus rotundus, Digitaria sanguinalis, Cucumis sp. etc.

2. **Technology**

   Apply 10 t/ha paddy straw mulch at the time of planting and if needed, do one hand weeding at 3 months after planting. All other recommended package of practices are followed to grow the crop organically.

3. **Crop yield**

   Rhizome yield – 33.07 t/ha

4. **Economics**

   a. Total cost of cultivation: Rs 88125/ha
   b. Cost of weed management: Rs 11250/ha
   c. Net returns: Rs 176435/ha
   d. BC ratio: 3.0

Paddy straw mulch (10 t/ha) in turmeric crop

Unweeded turmeric crop

Tamil Nadu

Okra + leafy coriander- maize+cowpea cropping system

1. **Weed flora**

   Trianthema portulacastrum, Digera muricata, Amaranthus viridis, Portulaca oleracea, Desmodium triflorum, Parthenium hysterophorus, Boerhaavia erecta, Cynodon dactylon, Chloris barbata, Dactyloctenium aegyptium, Echinochloa colona, Setaria verticilliata, Dinebra retroflexa, and *Cyperus rotundus.*

2. **Technology**

   Apply crop residue mulch 5 t/ha at the time of sowing in okra and in maize, twin wheel hoe weeder weeding on 20 DAS + crop residue mulching @ 5 t/ha. All other recommended package of practices are followed to grow the crop organically.

3. **Crop yield**

   Okra fruit yield– 30.2 t/ha, maize grain yield – 5.71 t/ha

4. **Economics**

   a. Total cost of cultivation: okra (Rs 27500/ha); maize (Rs 17500/ha)

   b. Cost of weed management: okra (Rs 1250/ha); maize (Rs 1750/ha)

   c. Net returns: okra (Rs 540000/ha); maize (Rs 39546/ha)

   d. BC ratio: okra (5.87); maize (2.61)

Twin wheel hoe weeder at 20 DAS + crop residue mulching (5 t/ha) in maize crop

Hand weeding 20 DAS *fb* mulching in okra crop

Telangana

Okra- carrot cropping system

1. **Weed flora**

   Okra: *Cyperus rotundus, Rottboellia* spp., *Cynodon dactylon, Dactyloctenium aegyptium, Commelina benghalensis, Parthenium hysterophorus, Trianthema portulacastrum, Digera arvensis* and *Celosia argentea.*

   Carrot: *Cyperus rotundus, Parthenium hysterophorus, Alternanthera paranychioides, Melilotus alba, Digera arvensis, Blumea* sp. and *Sonchus* sp.

2. **Technology**

   Inter-row rice straw mulching (5 t/ha) followed by intra-row weeding at 30 DAS in both okra and carrot. All other recommended package of practices are followed to grow the crop organically.

3. **Crop yield**

   Okra yield of 1.93 t/ha and carrot root yield of 13.64 t/ha could be obtained. After completion of the four cycles of the okra-carrot system, the organic carbon status of the soil increased significantly in rice straw mulch (5 t/ha) treatment from 0.51% to 0.64%.

4. **Economics (total system based)**

   a. Total cost of cultivation: Rs 134502/ha,
   b. Cost of technology: Rs 17500/ha,
   c. Net returns: Rs 390438/ha
   d. BC ratio: 3.90

Rice straw mulch (5 t/ha) in okra crop

Rice straw mukh (5 t/ha) in carrot crop

Uttarakhand

Rice – wheat cropping system

1. **Weed flora**

   Rice: *Echinochloa colona, Echinochloa crus-galii, Panicum* sp., *Cynodon dactylon, Ammannia baccifera, Commelina benghalensis, Cyanotis axillaris, Phyllanthus niruri, Cyperus difformis, Cyperus iria, Paspalum distichum, Fimbristylis miliacea, Cyperus difformis* and *Leptochloa chinensis.*

   Wheat: *Phalaris minor, Chenopodium album, Fumaria parviflora, Cirsium arvense, Anagallis arvensis, Vicia hirsuta, Vicia sativa, Melilotus alba, Meliotus indica, Lathyrus aphaca, Argemone mexicana, Rumex acetosalla* and *Medicago denticulata.*

2. **Technology**

   In *Kharif*, direct-seeded rice is sown and *Sesbania* at 20 kg/ha is sown in between the rows of rice. *Sesbania* incorporation is done at 25 DAS with cono-weeder followed by one hand weeding at 40 DAS. In *Rabi*, wheat is sown *fb* one hand weeding at 30 DAS.

3. **Crop yield**

   Rice – 2.20 t/ha; wheat – 3.50 t/ha

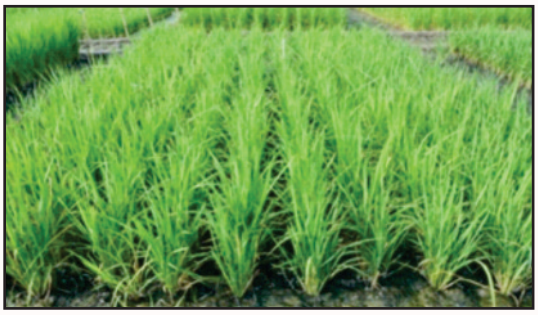
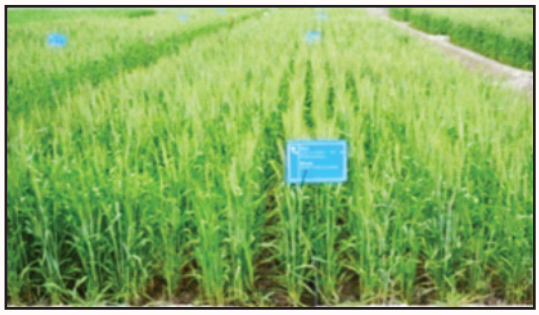
4. **Economics**

   a. Total cost of cultivation: Rice - Rs 45000/ha; wheat - Rs 41000/ ha

   b. Cost of weed management: Rice - Rs 11000/ha; wheat - Rs 5000/ha

   c. Net returns: Rice - Rs 23750/ha; wheat - Rs 43000/ha

   d. BC ratio: Rice - 1.52; wheat - 2.0

Organic rice – wheat crop

West Bengal

Guava orchard

1. **Weed flora**

   Cyperus rotundus, C. difformis, Cynodon dactylon, Alternanthera philoxeroides, Physalis minima, Commelina benghalensis, Convolvulus arvensis, Solanum xanthocarpum and *Cucumis sativus.*

2. **Technology**

   Grow leafy vegetable red amaranthus throughout the year in between rows of guava plants during initial years of the orchard for weed suppression, additional yield and benefits.

3. **Crop yield**

   Guava – 2.97 t/ha; Red amaranthus – 3.72 t/ha

   System yield (guava equivalent): 4.01 t/ha

4. **Economics**

   a. Total cost of cultivation: Rs 68244/ha
   b. Cost of weed management: Rs 6515/ha
   c. Net returns: Rs 111920/ha
   d. BC ratio: 2.64

Red amaranthus crop in between Guava rows

Unweeded guava crop

Table 1. Scientific and common name of weeds

Sl.No.	Scientific name	English	Hindi
1.	*Acanthospermum hispidum* D.C.	Bristly starbur, Goat's head, Hispid starburr	कांटागोखरू
2.	*Arachne racemosa* (B.Heyne ex Roth) Ohwi	Goose grass	जौरा
3.	*Aeschynomene indica* L.	Indian Joint Vetch, Curly-indigo, Sensitive jointed vetch	सोला
4.	*Ageratum conyzoides* L.	Billy goat-weed, Chick weed,	महकुआ
5.	*Ageratum houstonianum* Mill.	Blue billy goat weed, Floss flower	
6.	*Alternanthera paronychioides* A. St.Hil.	Brazilian spinach, Sessile joy weed, Dwarf copper leaf	
7.	*Alternanthera bettzickiana* (Regel) G. Nicholson	Green Hedge, Calico plant	
8.	*Alternanthera philoxeroides* (Mart.) Griseb	Alligator weed, Pig weed	शिखरमत्स्याक्षी
9.	*Alternanthera sessilis* (L.) R.Br. ex DC.	Brazilian spinach, Sessile joy weed, Dwarf copper leaf.	मत्स्याक्षी
10.	*Amaranthus viridis* L.	Slender amaranth, Green amaranth.	जंगली चौलाई
11.	*Ammannia baccifera* L.	Blistering Ammannia, Tooth Cup	अगिनबूटी, बनमिरिच
12.	*Anagallis arvensis* L.	Scarlet pimpernel, Pimpernel	धरतीधाक, कृष्णनील
13.	*Argemone mexicana* L.	Mexican poppy, Mexican prickly poppy, Lowering thistle	शैलकांटा, सत्यानाशी
14.	*Avena ludoviciana* L.	Wild oat, Sterile oat	जंगलीजई
15.	*Axonopus compressus* (Sw.) P. Beauv.	Carpet grass, Broad-leaved carpet grass, Buffalo grass	
16.	*Bidens pilosa* L.	Black-jack, Beggarticks, Hairy beggar ticks, Cobbler's pegs, Devil's needles	कुमरा
17.	*Blumea lacera* (Burm.f.) DC.	Lettuce-leaf Blumea	कुकरौंधा
18.	*Boerhavia erecta* L.	Erect Spiderling, Erect boerhavia, Erect tar vine	श्वेता
19.	*Boerhavia diffusa* L. nom. Cons	Red hogweed, Tar vine, Red spiderling, Wine flower	बिसखपरा, गधाकंद, शोथाग्नी
20.	*Borreria hispida* (L.) Schum.	Shaggy button weed	वासुका, मदनघंटी
21.	*Brachiaria reptans* (L.) Gard	Creeping panic grass, Running grass, Para grass	पैराघास
22.	*Brachiaria ramosa* (L.) Stapf	Browntop millet, Dixie signalgrass	मकरा, मूरत
23.	*Caesulia axillaris* Roxb.	Pink node flower	गठीला
24.	*Cannabis sativa* L.	Hemp, Gallow grass	गाँजा
25.	*Cassia tora* L.	Sickle senna, Wild senna	चरोता, चकवड
26.	*Catharanthus pusillus* (Murray) G. Don	Tiny periwinkle	
27.	*Celosia argentea* L.	Plumed cockscomb, Silver cockscomb, White cockscomb, Flamingo feathers, White celosia	सिलमिली, गरखा, सिलवारी, सफेदमुर्ग
28.	*Chenopodium album* L.	Lamb's quarters, White goosefoot	बथुवा
29.	*Chloris barbata* Sw.	Swollen finger grass, Purple top chloris.	
30.	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Siam Weed, Bitter bush, Devil weed, Hagonoy, Jack in the bush, Triffid weed	तीव्रगंधा, बाघधोका
31.	*Cirsium arvense* (L.) Scop.	Creeping thistle, Field thistle, Canada thistle	च्युली
32.	*Cleome rutidosperma* DC.	Fringed spider flower, Consumption weed, Wild cat's whiskers,	उजलाहुलहुल

Table contd.

Sl.No.	Scientific name	English	Hindi
33.	*Cleome viscosa* L.	Asian spider flower, Yellow spider flower, Cleome, Tickweed	हुरहुरबागरो
34.	*Commelina benghalensis* L.	Bengal day flower, Whiskered commelina, Tropical spiderwort	कनकउआ
35.	*Commelina diffusa* Burm.f.	Spreading dayflower, Climbing dayflower, Scurvy weed	
36.	*Commelina communis* L.	Commelina	
37.	*Convolvulus arvensis* L.	Field bindweed	हिरनपग, हिरनखुरी
38.	*Cucumis sativus* L.	Cucumber	खीरा
39.	*Cuphea carthagenensis* (Jacq.) J.F. Macbr.	Colombian wax weed	
40.	*Cyanotis axillaris* (L.) D. Don ex Sweet	Creeping cradle plant	काना
41.	*Cynodon dactylon* (L.) Pers.	Bermuda grass, Bahama grass, Couch grass, Dog's tooth grass; quick grass, star grass	दूब
42.	*Cyperus difformis* L.	Small-flowered nutsedge	डीला, मोथा
43.	*Cyperus iria* L.	Rice flats edge and Umbrella sedge	मोथा
44.	*Cyperus rotundus* L.	Common nut sedge, Coco grass, Nutgrass, Purple nutsedge	नागरमोथा
45.	*Dactyloctenium aegyptium* (L.) Willd.	Crowfoot grass, Beach wire grass, Comb fringe grass, Duck grass, Egyptian finger grass	मकड़ा
46.	*Desmodium triflorum* (L.) DC.	Creeping Tick trefoil, Three-flower beggar weed	तिपतिया
47.	*Digera muricata* (L.) Mart.	False amaranth	लहसुआ
48.	*Digitaria ciliaris* (Retz.) Koeler	Southern crabgrass, Tropical finger-grass, Tropical crabgrass	
49.	*Digitaria sanguinalis* (L.) Scop.	Purple crabgrass, Hairy crab grass, Large crabgrass	हरियानबी
50.	*Digitaria setigera* Roth ex Roem. & Schult.	East Indian crabgrass	
51.	*Dinebra retroflexa* (Vahl) Panz.	Viper Grass, Cats tail grass	
52.	*Echinochloa colona* (L.) Link	Jungle rice, awnless barnyard grass	जंगलीसाँवा
53.	*Echinochloa crus-galli* (L.) Beauv	Barnyard grass	साँवाघास
54.	*Eclipta alba* (L.) Hassk.	Trailing Eclipta plant	भांगरा, भृंगराज
55.	*Eleusine indica* (L.) Gaertn.	Goose grass	मंडला
56.	*Eragrostis major*	Love grass, Cane grass	
57.	*Eragrostis tenella* (A. Rich.) Hochst. ex Steud.	Japanese love grass	भारभूसी
58.	*Euphorbia geniculata* Ortega	Wild poinsettia, Lesser green poinsettia	बड़ीदुधी
59.	*Euphorbia hirta* L.	Asthma weed, Dove milk, Common spurge, Cats hair	दुधी
60.	*Fimbristylis miliacea* (L.) Vahl	Fringerush, globe	घुइन, दिल्ली
61.	*Fumaria parviflora* Lam.	Small flower Fine leaf fumitory, fine-leaved fumitory and Indian fumitory.	
62.	*Galinsoga parviflora* Cav.	Gallant soldier, small-flower galinsoga, littleflower quickweed	पीपली
63.	*Heliotropium indicum* L.	Indian heliotrope, Indian turnsole	हाथजोड़ी
64.	*Ischaemum rugosum* Salisb.	Saramollagrass, Wrinkle duck beak, saromacca grass	मरोंडा, मुरची
65.	*Lathyrus aphaca* L.	Yellow pea, Yellow vetchling	जंगलीमटर
66.	*Leptochloa chinensis* (L.) Nees	Chinese sprangle top, Red sprangletop.	
67.	*Lindernia crustacea* (L.) F.Muell.	Malaysian false pimpernel, Hard slitwort	
68	*Ludwigia parviflora* Roxb.	Creeping water primrose, Willow primrose	लवंगी

Table contd.

Sl.No.	Scientific name	English	Hindi
69.	*Ludwigia linifolia* Poir.	Flaxleaf seedbox; South eastern Primrose Willow	
70.	*Ludwigia perennis* L.	Perennial water primrose, Paddy clove	
71.	*Marsilea quadrifolia* L.	European water-clover	सुशनी
72.	*Mecardonia procumbens* (Mill.) Small	Baby jump up, Yellow-flowered water hyssop	
73.	*Medicago denticulata* L.	California burclover, Toothed bur clover,burr medic	चान्दंसी, चुरगाली
74.	*Medicago polymorpha* L.	Bur Clover, Bur medic, Toothed medic	मैना, चान्दंसी, चुरगाली
75.	*Melilotus alba* (L.) Medik	Honey clover, White melilot, White sweetclover	सफ़ेदसेंजी
76.	*Melilotus indica* (L.) All.	Indian Sweet Clover, Yellow sweet clover, Small Melilot	पीलीसेंजी
77.	*Mikania micrantha* Kunth	American rope, Bitter vine, Climbing hemp vine, Mikania vine, Mile-a-minute weed	
78.	*Mimosa pudica* L.	Common sensitive plant, Humble plant, live and die, Live-and-die, Mimosa, Shame lady, Shame bush, Touch-me-not	छुइमुइया, लज्जावती
79.	*Mitracarpus verticillatus* (Schumach. & Thonn.) Vatke	Tropical girdle pod	
80.	*Monochoria vaginalis* (Burm.f.) C.Presl	Heart shape false pickerel weed, Oval-leaved monochoria, Pickerel weed. Sprawling dickwort.	ननका,पानपत्ता
81.	*Oldenlandia corymbosa* L.	Diamond Flower, Flat-top mille graines, Old world diamond-flower, Wild chayroot	दमनपप्पड़, पित्तपापड़ा
82.	*Oldenlandia umbellata* L.	Chay Root, Indian madder, Choy root	
83.	*Oplismenus burmannii* (Retz.) P. Beauv.	Wavy-leaf basket grass	
84.	*Panicum maximum* - Jacq.	Guinea grass, Buffalo grass	
85.	*Panicum dichotomiflorum* Michx.	Smooth witch grass, Fall panic grass, Autumn millet	
86.	*Panicum repens* L.	Torpedo grass, Bullet grass, Couch panicum, Creeping panic grass, Quack grass.	
87.	*Parthenium hysterophorus* L.	Carrot grass, Santa maria feverfew, Ragweed Parthenium, Whitetop weed	गाजरघास या चटक चांदनी
88.	*Paspaladium flavidum* (Retz.) A.Camus	Yellow water crown grass	
89.	*Paspalum distichum* L.	Knotgrass, Water finger-grass, Couch paspalum, Eternity grass, Gingergrass, Thompson grass	बेसक
90.	*Paspalum scrobiculatum* L.	Indian paspalum, Creeping paspalum, Water couch	कोदो, कोदवा
91.	*Pennisetum pedicellatum* Trin.	Nigeria grass, Hairy fountain grass	दीनानाथघास
92.	*Phalaris minor* Retz.	Little seed canary grass, Small-seeded canary grass, Lesser-canary grass,	गेहुंसा, गुल्लीडंडा, गेहूं का मामा
93.	*Phyllanthus niruri* L.	Gale of the wind, Stonebreaker	भुंईआंवला
94.	*Physalis minima* L.	Little Gooseberry, Native gooseberry, Wild cape gooseberry and Pygmy ground cherry	पिपट, बनतिपरिया, रसभरी
95.	*Poa annua* L.	Annual bluegrass, Annual meadow grass	
96.	*Polygonum alatum* (D.Don) Buch.-Ham. ex Spreng	Nepalese smartweed	
97.	*Polypogon monspeliensis* (L.) Desf.	Annual beard-grass, Annual rabbits foot grass	
98.	*Portulaca oleracea* L.	Purslane, Little hogweed	लोहड़ी
99.	*Ranunculus arvensis* L.	Field buttercup, Corn buttercup, Corn, crowfoot, European field buttercup, Hunger weed	
100.	*Rottboellia cochinchinensis* L.	Itch grass, Guinea-fowl grass, Jointed grass	

Table contd.

Sl.No.	Scientific name	English	Hindi
101.	*Rumex acetosella* L.	Red sorrel, Sheep's sorrel, Field sorrel, Sour weed	चुक
102.	*Rumex dentatus* L.	Toothed dock and Aegean dock	जंगलीपालक
103.	*Marsilea quadrifolia* L.	Tussock drop seed	
104.	*Solanum nigrum* L.	Black nightshade, Deadly nightshade	मकोय
105.	*Scoparia dulcis* L.	Sweet broom weed, Sweet broom wort	मीठीपत्ती, घोड़ातुलसी
106.	*Setaria glauca* L.	Golden foxtail, Wild millet	बंदरी, बनकौनी
107.	*Setaria verticillata* (L.) P.Beauv.	Bristly Foxtail, Bur bristle grass, Bur grass, Foxtail, Hooked bristle grass	चिरचिटा, बरचिट्टा
108.	*Solanum virginianum* L.	Yellow berried, Night shade	भरकटैया या कंटकारी
109.	*Sonchus arvensis* L.	Field sow thistle, Hare thistle, Field milk thistle	दूधी
110.	*Sorghum halepense* (L.) Pers.	Aleppo grass, Johnson grass	जंगलीजोवार, बारू, चिन्ना
111.	*Spergula arvensis* L.	Corn spurry, Field spurry, Devil's gut, Pickpurse, Sandweed	बनधनिया
112.	*Spermacoce hispida* L.	Shaggy button weed	
113.	*Spilanthes acmella* Murr.	Toothache plant, Szechuan buttons, Buzz buttons, Ting flowers, Electric daisy	अकरकरा
114.	*Stellaria media* (L.) Vill.	Common chickweed, Chickweed, Starweed, Star chickweed	बुच-बुचा
115.	*Trianthema portulacastrum* L.	Giant pigweed, Black pigweed	पत्थरचटा
116.	*Tridax procumbens* L.	Coat buttons, Tridax daisy	घमरा
117.	*Tulipa asiatica* L.	Tulip	
118.	*Vicia hirsuta* (L.) Gray	Tiny vetch, Hairy vetch	झुनझुनी आंकरी, मसूरी, मुनमुना
119.	*Vicia sativa* L.	Common vetch, Garden vetch	आँकरा, मटरी

Appendix-II

Table 2. List of contributors

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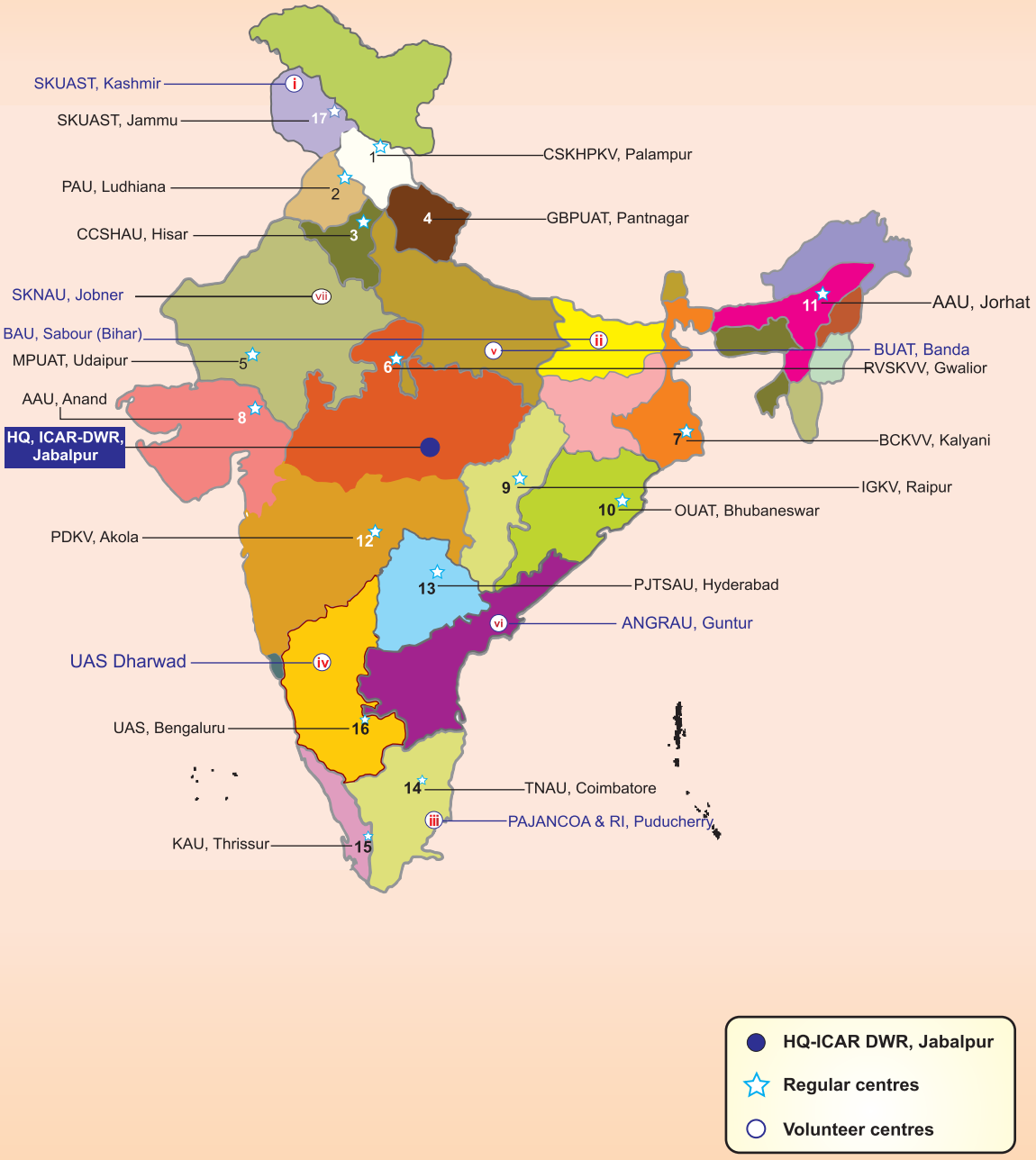
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AAU, Anand
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