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1. GENERAL INFORMATION

Annual Progress report of the All India Co-ordinated Research Programme on Weed Control - for the year 1990-91. Trichur Centre

1. a) Name and address of Institution : Kerala Agricultural University
Vellanikkara 680 654
TRICHUR.
- b) Location of work : Department of Agronomy
College of Horticulture
Kerala Agricultural University
Vellanikkara 680 654
Trichur.
2. Name of the Principal Investigator : Dr.C.T.Abraham
Associate Professor of Agronomy
3. Project title : All India Co-ordinated
Research Programme on
Weed Control.
4. Grant No. : ICAR - 3 -14/85 - AFC dt:4/7/90.
5. Date of start : ICAR - 1.4.1990
6. Date of expiry : ICAR - 31.3.1991
7. Period covered by the report : 1.4.1990 to 31.3.1991.
8. a) Project Objectives : Work out effective and economic
weed control schedules for
field, plantation crops and
in different aquatic bodies; ...
survey of weed flora, their
distribution, ecology and
habitat; study on ecology
and control of problem weeds
including aquatic and parasitic
weeds, long term residual &
cumulative effects of herbicides;

Standardise bio³-assay
technique for estimating
herbicide residue in soil,
crop and water systems; testing
of available tools/ implements
for weed management under
various management systems and
training extension personnel
in weed management.

b) Objectives covered
in this report

: The progress of work for
achieving the objectives
are reported.

Staff position - 1990-'91

Sanctioned post	No. of posts	Person holding charge	Period	
			From	To
1. Asst. Professor (Agron)	1	Dr. C.T. Abraham	1.4.86	to 20.3.91
		Dr. (Mrs.) P. Sreedevi	21.3.91	continuing
2. Jr. Asst. Professor (Agron)	1	Sri. C. George Thomas	1.10.'86	to continuing
3. Main Asst. Gr. II	1	Sri. A.K. George	8.5.89	to 6.6.1990
		Sri. P.B. Bhashajan	7.6.'90	continuing
4. Assistant Gr. II	1	Smt. C. Rajalakshmi	1.12.87	continuing
5. L.D.V. Driver	1	Sri. V.R. Chandran	1.12.86	continuing

Financial statement (1990-91)

Budget Head	Sanctioned outlay	Expenditure
Salaries and benefits	1,63,000	1,54,478
T.A.	6,000	5,767
Recurring contingencies	36,000	36,313
Total	2,05,000	1,96,558

DETAILED REPORT

Background of the project

Kerala is well known for the production of various plantation crops. Out of the total cropped area of 28.6 lakh hectares, 15.5 lakh ha (54.2%) is under plantation crops such as coconut, rubber, tea, coffee, cardamom, ginger etc. The area under rubber, coconut, cardamom and ginger are the maximum in Kerala State. Plantation crops have a significant role in the economy of the State. Even a small increase in productivity of these crops will have a significant effect. Being located in the tropical zone with warm humid climate, weed problems are severe in the crops of Kerala. However, detailed research on the weed problems and their management are yet to be conducted and hence there is no specific recommendation for weed management in these crops. This centre of the project was sanctioned for catering to the research needs in this line.

The Director, FERRO, American Embassy, New Delhi, in his letter of 6th September, 1985, communicated their willingness to make a grant of Rs.7,09,526.00 to the Kerala Agricultural University for undertaking a research project "All India Co-ordinated Research Programme on Weed Control in Plantation Crops" over a period of four years. The documents were signed on 14.10.1985 and the centre started functioning at the College of Horticulture, Vellanikkara, Trichur from 1.12.1985.

The duration of the project was further extended to 31.3.1990 by the ICAR (No.2(30)/84-FAS dated 30.10.1989 of ICAR). From 1.4.1990 the Centre is being financed by the ICAR funds. Continuous sanction for the project during the year 1990-91 was obtained by F.No.3-14/85-A.F.C. dated 4.4.1990 of ICAR.

The main objectives of the programme are:

- (1) Conduct studies to estimate the crop losses due to weeds in major plantation crops and their cropping systems.
- (2) Develop suitable weed management recommendations for plantation crops and associated cropping systems.
- (3) Conduct studies on the biology and control of problem weeds in plantation crops
- (4) Conduct of a survey to find out the crop-weed associations in major crops of the state and
- (5) Prepare a weed map of the State

Progress of work

The following trials were conducted during 1990-91

1. Survey of weed flora of Kerala
2. Weed management in coffee gardens
3. Weed management in cardamom plantation
4. Control of Chromolaena odorata with post emergence application of herbicides
5. Evaluation of post-emergence herbicides for controlling Pennisetum polystachyon
6. Control of Eleocharis sp with herbicides
7. Observational trial for the weed control in Pokkali rice
8. Effect of adjuvants on the efficiency of glyphosate
9. Method of application of pre-emergence herbicides in direct sown pudelléd rice.

This report presents the progress of these trials during the period 1990-91

I. Survey of weed flora of Kerala

The survey of weeds was conducted in the Central zone of Kerala.

by

The survey was conducted/travelling along the major roads of the region so as to get a representation of the

entire region and making observations on the weeds at sites every 10 km intervals. At every site species wise counts of all the weeds present in one m² area will be noted from four random places and the average value will be recorded.

From the observations, percentage frequency, average density and frequency density index (FDI) of each species were worked out.

$$\text{Percentage frequency} = \frac{\text{Number of sites where a species occur}}{\text{Total number of sites}} \times 100$$

$$\text{Average density} = \frac{\text{Total count of the species from all the sites}}{\text{Number of sites where the weed is present}}$$

$$\begin{aligned} \text{Frequency density index} &= \frac{\text{Percentage frequency} \times \text{Density}}{100} \end{aligned}$$

Central zone

The central zone consists of three Central districts of Kerala viz., Ernakulam, Thrissur and Palakkad excluding the highranges, coastal saline tracts and other isolated areas like kole lands with special soil and physiographic conditions. The crops raised are mainly rainfed. This zone is the major rice growing tract of the State and accounts for about 50 per cent of the area under rice and 52% of the production of rice, rice, Coconut, arecanut, groundnut, sesame, pulses, banana and pineapple are the other important crops of the zone. The geographical area of the zone is 973689 ha.

The survey of weed flora was undertaken in the tract in kharif, 1990 and the kharif crops were covered. The present survey consisted of a total of 107 sites, of which 55 in rice, 18 in coconut, 10 in rubber, 8 in arecanut, 8 in cassava and 8 in banana.

a. Rice:

In rice crop, mainly the semi-dry system of cultivation is followed during kharif in the zone. A total number of 49 weed species were noted, of which 11 were grasses, 6 were sedges 28 were broadleaf weeds and 4 were ferns (Table 1). The major grassy weeds were Sacciolepis interrupta, Isachne miliacea, Echinochloa colona and Oryza rufipogon, Cyperus albo-marginatus, Cyperus haspan, Cyperus difformis and Schoenoplectus lateriflorus were the major sedges observed. Among the broadleaf weeds, Eriocaulon quinquangulare, Dopatrium junceum, Ammania baccifera, Monochoria vaginalis, and Ludwigia perennis were frequently seen. Ferns were not widespread. Marselia quadrifoliatum was seen in more fields than other fern weeds.

b. Coconut garden

The weeds noted in coconut gardens were presented in Table 2. A large number of weeds were seen. However, most frequently seen weeds were less. Among grassy weeds, Ischaemum spp, Oplismenus burmanni, Alloteropsis cinicina, Dactyloctenium aegyptium, Axonopus compressus etc. were predominant. Sedges were relatively less. However, Cyperus spp and Kyllinga spp were occasionally seen. Among the large number of broadleaf weeds, Borreria spp, Chromolaena odorata, Mimosa pudica, Biophytum sensitivum, Leucas aspera, Ageratum conyzoides etc. were predominant.

c. Rubber

Rubber is grown mainly in the hilly terrains of the central zone. In young rubber gardens, it is a normal practice to grow cover crops and in such gardens weed problems are less. In the garden surveyed, the major grassy weeds were Ischaemum indicum, Oplismenus burmanni and Axonopus compressus. Pennisetum polystachyon and Pennisetum pedicellatum proliferates in young gardens

Table 1
 Weed flora of Central zone of Kerala

Rice fields

Name of weed	Frequen- cy	Average density No/m ²	Frequency density index
<u>Grasses</u>			
Brachiaria mutica	1.82	1.00	0.02
Echinochloa colona	45.46	2.36	1.07
E. crusgalli	5.46	1.33	0.07
E. glabrescence	3.64	4.00	0.15
Eragrostis spp.	1.82	1.00	0.02
Ischne miliacea	74.55	11.07	8.26
Ischaemum rugosum	7.27	1.50	0.11
Leptochloa chinensis	7.27	2.75	0.20
Oryza rufipogon	40.00	2.27	0.91
Paspalam paspaloides	14.55	1.38	0.20
Saccolipsis interrupta	78.18	5.16	4.04
<u>Sedges</u>			
Cyperus albo-marginatus	45.46	2.72	1.24
Cyperus difformis	21.82	5.17	1.13
Cyperus haspan	36.36	4.10	1.49
Cyperus iria	29.09	2.38	0.69
Finbristylis miliacea	29.09	2.69	0.78
Schoenoplectus lateriflorus	10.91	8.50	0.93
<u>Broad leaf weeds</u>			
Aeschynomene indica	3.64	2.00	0.07
Atternanthera sessilis	18.18	1.00	0.18
Ammania baccifera	30.90	6.71	2.07
Amischophacelus axillaris	14.50	1.62	0.24
Cleome viscosa	1.82	6.00	0.11
Cynotis sp.	1.82	1.00	0.02
Dopatrium junceum	21.82	10.80	2.36
Eclipta prostrata	7.27	1.25	0.11
Eriocaulon cuspidatus	18.20	13.70	2.49

Contd.....

Name of weed	Frequency	Average density No/m ²	Frequency density Index
<i>Eriocaulon quinquangulare</i>	23.64	16.31	3.36
<i>Geissosporis cristata</i>	1.82	3.00	0.06
<i>Hedyotis diffusa</i>	1.82	3.00	0.06
<i>Hydrolea zeylanica</i>	3.64	1.50	0.06
<i>Hygrophila auriculata</i>	1.82	3.00	0.06
<i>Limnophila indica</i>	7.27	6.25	0.45
<i>Limnophila repens</i>	1.82	6.00	0.11
<i>Lindernia ciliata</i>	5.46	2.67	0.15
<i>Lindernia hyssopoides</i>	10.91	2.00	0.22
<i>Lindernia parviflora</i>	7.27	2.50	0.18
<i>Lobelia trigone</i>	5.46	2.67	0.15
<i>Ludwigia perennis</i>	69.10	1.74	1.20
<i>Melochia corchorifolia</i>	5.46	2.33	0.13
<i>Molluga pentaphylla</i>	5.46	2.33	0.13
<i>Monochoxia vaginalis</i>	36.36	3.80	1.38
<i>Nymphaea stellata</i>	5.46	2.67	0.15
<i>Rotala macrandra</i>	10.91	4.67	0.51
<i>Sphaeranthus indicus</i>	5.46	2.00	0.11
<i>Sphenoclea zeylanica</i>	10.91	7.50	0.82
<u>Ferns</u>			
<i>Azolla pinnata</i>	3.64	30.00	1.09
<i>Ceratopteris thalictroides</i>	9.09	1.60	0.15
<i>Marsilia quadrifoliata</i>	29.09	3.00	0.87
<i>Salvinia molesta</i>	9.09	26.80	2.44

Number of sites surveyed - 55

Table 2
Weed flora of Central zone of Kerala
Coconut gardens

Name of weed	Frequency	Average density No/m ²	Frequency density index
<u>Grasses</u>			
<i>Alloperosia cimicina</i>	50.00	4.0	2.00
<i>Axonopus compressus</i>	37.50	4.33	1.62
<i>Brachiaria distachya</i>	50.00	2.63	1.32
<i>Cynodon dactylon</i>	25.00	4.25	1.06
<i>Dactyloctenium aegyptium</i>	50.00	3.50	1.75
<i>Digitaria ciliaris</i>	25.00	3.25	0.81
<i>Digitaria bicornis</i>	6.25	1.00	0.06
<i>Echinochloa colona</i>	12.50	2.00	0.25
<i>Eleusine indica</i>	12.50	2.00	0.25
<i>Eragrostis tenella</i>	12.50	8.50	1.06
<i>Eragrostis uniloides</i>	6.25	2.00	0.13
<i>Ischaemum spp.</i>	81.25	9.38	7.62
<i>Oplismenus burmanni</i>	31.25	7.60	2.38
<i>Panicum repens</i>	12.50	2.00	0.25
<i>Pennisetum pedicellatum</i>	6.25	2.00	0.13
<i>Pennisetum polystachyon</i>	12.50	5.00	0.63
<i>Perotis latifolia</i>	12.50	1.50	0.19
<i>Setaria pallide - fusca</i>	25.00	2.75	0.69
<i>Sporobolus diander</i>	12.50	2.00	0.25
<u>Sedges</u>			
<i>Cyperus compressus</i>	12.50	1.00	0.13
<i>Cyperus distans</i>	12.50	1.00	0.13
<i>Cyperus iria</i>	12.50	2.00	0.25
<i>Kyllinga brevifolia</i>	25.00	2.00	0.50
<i>Kyllinga monocephala</i>	25.00	2.00	0.50
<i>Murdania spp</i>	12.50	2.00	0.25

Contd.. ..

Name of weed	Frequency	Average density No/m ²	Frequency density index
Broad leaf weeds			
a) Monocots			
<i>Colocasia esculenta</i>	25.00	2.25	0.56
<i>Commelina benghalensis</i>	12.50	1.50	0.19
<i>Commelina diffusa</i>	6.25	3.00	0.19
<i>Curculigo orchicoides</i>	6.25	6.00	0.38
<i>Curcuma spp.</i>	12.50	3.50	0.44
<i>Cynotis spp.</i>	6.25	3.00	0.19
b) Dicot weeds			
<i>Acanthospermum hispidum</i>	6.25	1.00	0.06
<i>Aerva lanata</i>	12.50	2.00	0.25
<i>Ageratum conyzoides</i>	43.75	2.71	1.19
<i>Alysicarpus vaginalis</i>	6.25	1.00	0.13
<i>Amaranthus spinosus</i>	6.25	1.00	0.13
<i>Amaranthus viridis</i>	6.25	1.00	0.13
<i>Biophytum sensitivum</i>	43.75	4.57	2.00
<i>Blainvillea acnella</i>	6.25	1.00	0.13
<i>Blumea mollis</i>	12.50	1.50	0.19
<i>Borreria articulata</i>	25.0	15.00	3.75
<i>Borreria ocymoides</i>	12.50	2.00	0.25
<i>Calycopteri floribunda</i>	6.25	1.00	0.13
<i>Centella asiatica</i>	25.00	2.25	0.56
<i>Chromolaena odorata</i>	68.75	2.27	1.57
<i>Cleome viscosa</i>	6.25	1.00	0.06
<i>Clerodendron viscosum</i>	31.25	1.60	0.50
<i>Cyathula prostrata</i>	12.50	1.50	0.19
<i>Desmodium triflorum</i>	25.00	3.50	0.88
<i>Eclipta prostrata</i>	6.25	1.00	0.13
<i>Elephantopus scaber</i>	18.75	1.33	0.25
<i>Girardinia zeylanica</i>	12.50	1.00	0.13
<i>Hyptis suaveolens</i>	25.00	2.25	0.56
<i>Justicia prostrata</i>	6.25	1.00	0.13

Contd.....

Name of weed	Frequency	Average density No./m ²	Frequency density Index
<i>Leucas aspera</i>	56.25	3.33	1.87
<i>Leucas urticaefolia</i>	12.50	2.00	0.25
<i>Ludwigia perennis</i>	31.25	1.40	0.14
<i>Mikania micrantha</i>	18.75	4.33	0.81
<i>Mimosa pudica</i>	93.75	2.07	1.94
<i>Mitracarpus verticillatus</i>	6.25	10.00	0.63
<i>Naregomia alata</i>	12.50	2.00	0.25
<i>Peperomia pellucida</i>	12.50	1.50	0.19
<i>Phyllanthus niruri</i>	6.25	1.00	0.06
<i>Pouzolzia zeylanica</i>	25.00	3.50	0.88
<i>Rhyncosia minima</i>	6.25	3.00	0.19
<i>Scoparia dulcis</i>	18.75	1.67	0.31
<i>Sebestiana chamelea</i>	6.25	2.00	0.13
<i>Sida acuta</i>	6.25	3.00	0.19
<i>Sida rhombifolia</i>	6.25	3.00	0.19
<i>Stachytarpheta indica</i>	6.25	1.00	0.13
<i>Synedrella nodiflora</i>	18.75	5.00	0.94
<i>Triumfetta rhomboidea</i>	25.00	1.75	0.44
<i>Vernonia cineria</i>	18.75	1.67	0.31
<i>Waltheria indica</i>	18.75	1.67	0.31

No. of sites surveyed - 18

Table 3

Weed flora of Central zone of Kerala
Rubber gardens

Name of weed	Frequency (%)	Average density No/m ²	Frequency density index
<u>Grasses</u>			
<i>Allotheropsis cinicina</i>	10.00	1.00	0.10
<i>Apluda aristata</i>	10.00	2.00	0.2
<i>Axonopus compressus</i>	30.00	4.67	1.40
<i>Borachiaria distachya</i>	20.00	2.00	0.40
<i>Ischaemum indicum</i>	60.00	12.17	7.30
<i>Oplismenus burmanni</i>	50.00	7.4	3.7
<i>Pennisetum pedicellatum</i>	10.00	4.00	0.4
<i>Pennisetum polystachyon</i>	10.00	4.00	0.4
<u>Sedges</u>			
<i>Cyperus distans</i>	10.00	1.00	0.10
<i>Cyperus compressus</i>	10.00	2.00	0.20
<i>Kyllinga brevifolia</i>	40.00	3.25	1.30
<i>Murdannia sp.</i>	10.00	1.00	0.10
<u>Broadleaf weeds</u>			
a) Monocots			
<i>Commelina benghalensis</i>	30.00	1.00	0.3
<i>Commelina diffusa</i>	10.00	1.00	0.1
<i>Curculigo orchoides</i>	30.00	2.33	0.7
<i>Cynotis spp</i>	50.00	2.00	1.0
b) Dicot weeds			
<i>Ageratum conyzoides</i>	20.00	2.00	0.40
<i>Biophytum sensitivum</i>	40.00	3.00	1.2
<i>Borreria hispida</i>	40.00	11.25	4.50
<i>Borreria ocymoides</i>	20.00	1.00	0.2
<i>Centrosena pubescens</i>	10.00	2.00	0.20
<i>Chromolaena odorata</i>	40.00	3.50	1.40
<i>Clerodendron viscosum</i>	20.00	1.50	0.30
<i>Desmodium triflorum</i>	40.00	7.75	3.10
<i>Ipomosa pes-tigridis</i>	10.00	6.00	0.60

Name of weed	Frequency (%)	Average density	Frequency density index
Justicia decumbens	30.00	6.00	0.60
Justicia simplex	10.00	2.00	0.2
Mimosa pudica	70.00	1.00	0.70
Mitracarpus verticillatus	20.00	1.00	0.2
Lindernia crustacea	20.00	3.00	0.6
Passiflora foetida	10.00	1.00	0.10
Phyllanthus niruri	10.00	2.00	0.20
Pousolsia zeylanica	40.00	2.75	1.1
Sida rhombifolia	50.00	2.40	1.2
Spilanthes calva	20.00	1.00	0.2
Tragia involucrata	10.00	1.00	0.1
Triumfetta rhomboides	20.00	1.00	0.2
Vernonia cineria	10.00	1.00	0.1
Selaginella spp.	30.00	1.33	0.4

Number of sites surveyed - 10

where cover crops are not raised. Among broadleaf weeds, Borreria hispida, Chromolaena odorata, Justicia decumbens etc. were the major ones (Table 3).

d. Arecanut

The weed flora observed in arecanut garden is presented in Table 4. Opilismenus compositus, Ischaemum indicum, Daclyloctenium aegyptium, Brachiaria distachyon and Axonopus compressus were the predominant grasses observed in the survey. A few sedges were also occasionally found. Though broadleaf weeds were present, many of them were shade loving. Vigorously growing weeds were practically absent. Desmodium triflorum, Biophytum sensitivum, Lindernia crustacea, Pouzolsia zeylanica, Peperomia pellucida, Lercas aspera, Borreria spp, Cynotis spp etc. were the predominant broad leaf weeds observed.

e. Cassava

In cassava fields, the major grassy weeds were Ischaemum spp, Eragrostis spp, and Alloteropsis cimicina. The sedges, Cyperus compressus and Bulbostylis barbata etc. were occasionally seen. Among the broad leaf weeds, Borreria spp, Desmodium triflorum, Lindernia crustacea, Mitracarpus verticillatus, Mollugo disticha, Ludwigia perennis etc. were the major ones. The details of the weeds observed are presented in Table 5.

f. Banana

The main grassy weeds observed were Ischaemum spp, Alloteropsis cimicina, Cynodon dactylon and Perotis indica. Borreria spp, Ageratum conyzoides and vernonia cineria were the major broadleaf weeds found in the banana gardens. The sedges seen on Cyperus rotundus, C. compressus and C. iria were also occasionally present (Table 6)

Table 4

Weed flora of central zone of Kerala
Arecanut

Name of weed	Frequency (%)	Average density (No/m ²)	Frequency density index
<u>Grasses</u>			
<i>Alloteropsis cimicina</i>	12.5	9.00	1.13
<i>Chonopus compressus</i>	37.5	3.67	1.38
<i>Brachiaria distachya</i>	62.5	2.60	1.63
<i>Cynodon dactylon</i>	12.5	4.00	0.50
<i>Dactyloctenium aegyptium</i>	50.0	3.00	1.50
<i>Digitaria ciliaris</i>	25.0	1.50	0.38
<i>Echinochloa colona</i>	25.0	3.50	0.88
<i>Eleusine indica</i>	12.5	1.00	0.13
<i>Eragrostis uniloides</i>	12.5	1.00	0.13
<i>Ischaemum indicum</i>	62.5	4.00	2.50
<i>Opilismenus compositus</i>	75.0	29.5	22.13
<i>Paspalidium flavidum</i>	12.5	2.00	0.25
<i>Paspalum scrobiculatum</i>	12.5	2.00	0.25
<i>Sporobolus diander</i>	25.0	1.5	0.38
<u>Sedges</u>			
<i>Cyperus distans</i>	12.5	1.00	0.13
<i>Cyperus iria</i>	25.00	1.50	0.38
<i>Kyllinga brevifolia</i>	37.5	4.33	1.44
<i>Murdania spp</i>	12.5	5.00	0.63
<u>Broadleaf weeds</u>			
a) <u>Monocots</u>			
<i>Colocasia esculenta</i>	25.0	1.5	0.38
<i>Commelina benghalensis</i>	62.5	1.4	0.88
<i>Commelina diffusa</i>	37.5	1.67	0.62
<i>Cynotis nodiflora</i>	37.5	1.33	0.50
<i>Cynotis sp</i>	37.50	3.33	1.25
<i>Curculigo orchioides</i>	37.50	1.00	0.38
<i>Curcuma sp</i>	25.0	1.50	0.38

Comtd.....

Dicot weeds

Name of weed	Frequency (%)	Average density No/m ²	Frequency density index
<i>Acalypha indica</i>	12.50	4.00	0.50
<i>Ageratum conyzoides</i>	50.00	1.50	0.75
<i>Biophytum sensitivum</i>	75.00	4.33	3.25
<i>Borreria articularis</i>	25.00	1.50	0.38
<i>Borreria ocymoides</i>	25.00	4.00	1.00
<i>Celosia argentea</i>	12.50	1.00	0.13
<i>Centella asiatica</i>	25.00	1.00	0.25
<i>Controseta pubescens</i>	25.00	1.00	0.25
<i>Chromolaena odorata</i>	50.00	1.00	0.50
<i>Clerodendron viscosum</i>	12.50	1.00	0.13
<i>Cerchorus olitorius</i>	12.50	1.00	0.13
<i>Desmodium triflorum</i>	75.00	7.00	5.25
<i>Emilia sonchifolia</i>	25.00	2.00	0.50
<i>Euphorbia hirta</i>	12.50	1.00	0.13
<i>Girardinia zeylanica</i>	37.50	2.33	0.87
<i>Leucas aspera</i>	50.00	2.25	1.25
<i>Lindernia crustacea</i>	50.00	4.00	2.00
<i>Ludwigia perennis</i>	25.00	2.00	0.50
<i>Mimosa pudica</i>	25.00	3.00	0.75
<i>Mitracarpus verticillatus</i>	12.50	1.00	0.13
<i>Mollugo disticha</i>	12.50	1.00	0.13
<i>Peperomia pellucida</i>	37.50	3.67	1.38
<i>Phyllanthus niruri</i>	37.50	1.00	0.38
<i>Pouzolzia zeylanica</i>	50.00	2.75	1.38
<i>Scoparia dulcis</i>	12.50	1.00	0.13
<i>Sida rhombifolia</i>	12.50	1.00	0.13
<i>Spilanthes calva</i>	25.00	1.00	0.25
<i>Tragia involucrata</i>	25.00	1.00	0.25
<i>Triumfetta rhomboides</i>	25.00	1.00	0.25
<i>Urena lobata</i>	12.50	1.00	0.13

Table 5

Weed flora on Central zone of Kerala
Cassava fields

Name of weed	Frequency	Average density No/m ²	Frequency density index
<u>Grasses</u>			
<i>Allotheropsis ciliaris</i>	62.5	1.80	1.10
<i>Archopus compressus</i>	12.5	1.00	0.13
<i>Brachiaria distachya</i>	12.5	2.00	0.25
<i>Cynodon dactylon</i>	25.0	3.00	0.75
<i>Dactyloctenium aegyptium</i>	37.5	1.67	0.63
<i>Digitaria ciliaris</i>	12.5	3.00	0.38
<i>Eragrostis uniloides</i>	37.5	3.67	1.38
<i>Eragrostis tenella</i>	25.00	1.00	0.50
<i>Ischaemum spp</i>	37.5	5.00	1.88
<i>Perotis indica</i>	12.5	1.00	0.13
<u>Sedges</u>			
<i>Bulboslylis barbata</i>	25.00	4.50	1.13
<i>Cyperus compressus</i>	25.00	4.00	1.00
<i>Cyperus iria</i>	12.50	4.00	0.50
<i>Cyperus rotundus</i>	12.50	2.00	0.25
<u>Broadleaf weeds</u>			
a) <u>Monocots</u>			
<i>Cynotis spp</i>	25.0	2.5	0.63
<i>Murdania spp</i>	12.5	5.00	0.63
b) <u>Dicots</u>			
<i>Agenatum conyzoides</i>	12.5	4.00	0.50
<i>Biophytum sensitivum</i>	25.0	2.00	0.50
<i>Borreria articularis</i>	87.5	7.00	6.13
<i>Borreria ocymoides</i>	67.5	3.80	2.57
<i>Chromolaena odorata</i>	12.5	2.00	0.13
<i>Cleome monophylla</i>	12.5	2.00	0.25
<i>Cleome viscosa</i>	12.5	2.00	0.25
<i>Clerodondron viscosus</i>	25.0	1.00	0.25
<i>Cyclea peltata</i>	12.5	4.00	0.50

(Contd.)

Name of weed	Frequency (%)	Average density No/m ²	Frequency density index
<i>Desmodium triflorum</i>	50.0	4.75	2.38
<i>Helipta prostrata</i>	12.5	1.00	0.13
<i>Imilia souchifolia</i>	12.5	1.00	0.13
<i>Euphorbia hirta</i>	12.5	2.00	0.25
<i>Hyptis suaveolens</i>	25.0	1.5	0.38
<i>Leucas aspera</i>	25.00	2.5	0.38
<i>Lindernia crustacea</i>	50.0	3.5	1.75
<i>Ludwigia perennis</i>	37.5	3.33	1.25
<i>Melochia corchorifolia</i>	12.5	1.00	0.33
<i>Mitracarpus verticillatus</i>	62.5	2.20	1.38
<i>Mollugo disticha</i>	12.5	12.00	1.50
<i>Phytolanthus niruri</i>	25.0	1.00	0.25
<i>Physalis minima</i>	25.0	1.00	0.25
<i>Pouzolsia zeylanica</i>	25.0	2.50	0.88
<i>Sida acuta</i>	12.5	1.00	0.13
<i>Sida cordata</i>	12.5	1.00	0.13
<i>Sida rhombifolia</i>	12.5	2.00	0.25
<i>Spilanthus calva</i>	12.5	3.00	0.38
<i>Synedrella nodiflora</i>	12.5	3.00	0.38
<i>Tephrosia purpurea</i>	12.5	2.00	0.25
<i>Tridax procumbens</i>	12.5	2.00	0.25
<i>Triumfetta rhomboidea</i>	25.0	1.00	0.25
<i>Vernonia cineria</i>	50.0	1.75	0.88
<i>Vicca indica</i>	12.5	2.00	0.25
<i>Zornia gibbosa</i>	12.5	2.00	0.13

Number of sites surveyed - 8

Table 6

Weed flora of Central zone of Kerala

Banana gardens

Name of weed	Frequency (%)	Average density No/m ²	Frequency density index
<u>Grasses</u>			
Alloteropsis cimicina	25.0	8.00	2.00
Axonopus compressus	12.5	1.00	0.13
Borachiararia distachya	25.0	3.00	0.75
Cynodon dactylon	37.5	3.33	1.25
Dactyloctenium aegyptium	25.00	2.00	0.50
Echinochloa colona	12.5	3.00	0.38
Eragrostis uniloides	12.5	4.00	0.50
Ischaemum spp	37.5	6.00	2.25
Panicum repens	12.3	2.00	0.25
Perotis indica	25.0	4.00	1.00
<u>Sedges</u>			
Cyperus compressus	25.0	1.50	0.38
Cyperus iria	25.0	1.50	0.38
Cyperus rotundus	25.0	2.00	0.50
Broadleaf weeds			
a) Monocots			
Commelina spp	12.5	1.00	0.13
Cynotis spp	12.5	1.00	0.13
b) Dicots			
Ageratum conyzoides	50.0	4.5	2.5
Biophytum sensitivum	12.5	1.0	0.13
Borreria articularis	37.5	10.33	3.87
Borreria ocymoides	37.5	4.67	1.75
Cyclea peltata	12.5	4.00	0.50

Contd.....

Name of weed	Frequency (%)	Average density No/m ²	Frequency density index
<i>Desmodium triflorum</i>	12.5	1.00	0.13
<i>Emilia sonchifolia</i>	12.5	2.00	0.25
<i>Euphorbia hirta</i>	12.5	1.00	0.13
<i>Myrtis suaveolens</i>	12.5	1.00	0.13
<i>Leucas aspera</i>	37.5	2.33	0.88
<i>Lindernia crustacea</i>	12.5	1.00	0.13
<i>Ludwigia perennis</i>	12.5	1.00	0.13
<i>Mitracarpus verticillatus</i>	25.0	3.00	0.75
<i>Pouzolsia zeylanica</i>	25.0	1.00	0.25
<i>Vernonia cineria</i>	37.5	2.67	1.00
<i>Vicco indica</i>	12.5	1.00	0.13

Number of sites surveyed - 8



INTEGRATED WEED CONTROL IN SPECIFIC CROPS

1. WEED MANAGEMENT IN COFFEE GARDENS

Coffee is one of the important commercial plantation crop cultivated especially in the hilly tracts of the state. The area under coffee is 65,000 ha and production about 47,000 tonnes with a productivity of 722 kg/ha. Weed competition is very severe during the early part of the crop growth. The usually adopted practice by farmer is to give three or four slashings and a scraping just before harvesting. The present experiment was to evaluate various weed management methods involving herbicides to find out whether the prevalent costly weeding operations could be eliminated.

TECHNICAL PROGRAMME

1. Paraquat 0.4 kg/ha 2 sprays at monthly intervals
2. Paraquat 0.4 kg/ha + Diuron 1.0 kg/ha (Tank mix)
3. Glyphosate 0.8 kg/ha
4. Glyphosate 1.2 kg/ha
5. Glyphosate 0.8 kg/ha + Ammonium sulphate 1% in spray solution
6. Dalapon 3 kg/ha + 2,4-D 0.5 kg/ha (Tank mix) twice at monthly intervals
7. Dalapon 5 kg/ha + 2,4-D 1.0 kg/ha (tank mix) twice at monthly intervals
8. Sickle weeding (2,3 times depending on weed growth farmer's practice)
9. Unweeded control

Design : RBD
 Replication : 3
 Plot size : 40 m² (Approx.)

The trial was laid out in the coffee gardens of Cardamom Research Station, Pampadumpara. Spraying of herbicides started by the beginning of Monsoon in July-August. Herbicides were sprayed using a hydraulic sprayer fitted with a floodjet nozzle using 500 litres of water/ha.

Results

The results of the experiment is presented in Table No.7. The major weeds found in the garden were Paspalum conjugatum, Bidens pilosa, Crossocephala crepidodes, Isachne^{spp.}, Digitaria sp. etc.

The observations at one month after spraying showed that all the herbicides and herbicide combinations excepting dalapon + 2,4-D were statistically on par in the control of weeds. Among them glyphosate 1.2 kg/ha and paraquat 0.4 + diuron 1.0 kg/ha seems to have better effect. However, by two months, because of the repeated application of dalapon + 2,4-D all the weeds were found to be controlled. A slight improvement in the control is seen in the case of paraquat 0.4 kg/ha also. In the case of other herbicides, their effects seems to be lost by two months as is shown by increase in dry weight of weeds. By three months also, dalapon + 2,4-D spray maintained its better effects. However, the treatments paraquat 0.4 kg/ha thrice, paraquat 0.4 kg/ha + diuron 1.0 kg, glyphosate 0.8 kg + diuron 1.0 kg/ha, were also on par with it. In general the treatment dalapon 3.0 kg, + 2,4-D 0.5 kg/ha twice at monthly interval and paraquat 0.4 kg/ha twice at monthly interval gave satisfactory control of weeds upto three months.

2. WEED MANAGEMENT IN CARDAMOM PLANTATION

Cardamon is a shade loving spice crop cultivated in a plantation scale in the high range of Western Ghats. It is an important export oriented commodity of the state. The area under cardamon is about 64,000 ha with an annual production of about 2800 tons.

Table 7. Weed management in coffee gardens - Drymatter production of weeds (g/m^2) as influenced by the treatments

Treatments	Weed drymatter (g/m^2) at different stages		
	One month	Two months	Three months
Paraquat 0.4 kg twice	9.67 (3.023)*	0.67 (1.244)*	11.33 (3.118)*
Paraquat 0.4 + Diuron 1.0 kg	2.00 (1.656)	8.00 (2.606)	37.33 (4.991)
Glyphosate 0.8 kg	7.33 (2.851)	.67 (7.946)	84.67 (7.812)
Glyphosate 1.2 kg	2.00 (1.656)	50.67 (6.792)	34.67 (5.798)
Glyphosate 0.8 kg + Diuron 1.0 kg	2.33 (1.687)	44.00 (6.488)	13.67 (3.386)
Dalapon 3 kg + 2,4-D 0.5 kg twice	121.67(10.848)	0 (1.000)	8.67 (2.952)
Dalapon 5 kg + 2,4-D 1.0 kg twice	163.33(12.700)	0 (1.000)	2.67 (1.793)
Sickle weeding (twice)	50.00 (7.095)	185.33(13.442)	62.67 (7.592)
Unweeded control	199.33(13.837)	265.33(16.049)	292.00(17.112)
SE _{nt}	0.9869	1.2082	1.4981
CD (0.05)	2.9589	3.6222	4.4915

* $\sqrt{x+1}$ values

It is expected that use of suitable herbicides in the cardamom crop will protect the crop from weeds and related pest and diseases at the early stage, reduce the cost of cultivation, minimise the disturbance to the soil surface and loss of soil. Against this, back ground, an experiment was laid out at Indian Cardamom Research Institute farm Myladumpara to compare the efficiency of herbicidal and manual methods of weed control in cardamom.

Technical programme

Treatments

1. Unweeded control
2. Manually weeded control
3. Paraquat 0.4 kg/ha (2 sprays at bi-monthly intervals)
4. Paraquat 0.4 kg/ha + 2,4-D 1.0 kg/ha
5. Paraquat 0.4 kg/ha + Diuron 1.0 kg/ha (Tank mix)
6. Paraquat 0.4 kg/ha + Atrazine 1.0 kg/ha (Tank mix)
7. Glyphosate 0.8 kg/ha
8. Glyphosate 0.8 kg/ha + diuron 1.0 kg/ha (Tank mix)
9. Glyphosate 0.8 kg/ha + Atrazine 1.0 kg/ha (Tank mix)
10. Dalapon 5 kg/ha + 2,4-D 1.0 kg/ha (Tank mix)

Replication : 3

Plot size : 16 plants/plot

The herbicides were sprayed on the weeds only as directed spray @ 500 ltrs/ha. Observations were taken on the survived weed flora at one month, two month and three months after spraying.

Results

The effect of various treatments on weeds is given in the Table 3.

The weed flora of cardamom gardens was almost similar to coffee gardens. Paspalum conjugatum, Bidens pilosa, Crassocephalum crepidoides, Isachne sp etc are the major weeds. Weed problems are severe during the initial stages of the crop. When the

Table 3. Effect of herbicides on the weed population and weed biomass in cardamom plantation at 90 days after spraying.

Sl. No.	Treatments	Weed population/ 0.25 m ² area	Biomass of weeds (gms) 0.25m ² area
1.	Unweeded control (T ₁)	31.00	162.58
2.	Manually weeded (T ₂)	57.67	37.50
3.	Paraquat alone (T ₃)	25.33	75.57
4.	Paraquat + 2, 4-D (T ₄)	61.33	51.00
5.	Paraquat + Diuron (T ₅)	43.67	39.25
6.	Paraquat + Atrazine (T ₆)	32.00	19.92
7.	Glyphosate alone (T ₇)	86.00	30.00
8.	Glyphosate + Diuron (T ₈)	66.00	19.00
9.	Glyphosate + Atrazine (T ₉)	75.00	10.93
10.	Dalapon + 2,4-D(T ₁₀)	78.00	102.75
	SEM	11.73	18.18
	CD	34.85	54.03

canopy closes in weed growth become less.

The results indicated that spraying Paraquat 0.4 kg/ha resulted in the control of existing weeds upto two months. Glyphosate 0.8 kg/ha effectively controlled the grass weeds. However, there was subsequent germination of annual dicot weeds. Combining Atrazine 1.0 kg/ha or Diuron 1.0 kg/ha to Glyphosate resulted in prolonged weed control. Study on the selectivity of cardamom to the herbicides tested showed that 2,4-D may be phytotoxic, if sprayed on the plants. Based on the results of the preliminary trial, a detailed experiment will be laid out.

3. STUDIES ON CONTROL OF PROBLEM WEEDS

1. Control of Chronolaena odorata with post-emergence application of herbicides.

Chronolaena odorata (Eupatorium) is a very serious weed in the plantation crops of Kerala. The trial started earlier to find out the most effective post-emergence herbicide for controlling this weed was repeated in 1990 also.

The experiment was conducted on a perennial growth of Chronolaena odorata in a rubber garden.

Technical programme

<u>Herbicides</u>	<u>dose kg/ha</u>
1. Paraquat (4)	: 0.4, 0.6, 0.8, 1.0
2. 2,4-D (4)	: 1.0, 1.5, 2.0, 2.5
3. Glyphosate (4)	: 0.4, 0.8, 1.2, 1.6
4. Paraquat + Diuron (2)	: Paraquat 0.4 + Diuron 1.0 Paraquat 0.6 + Diuron 1.0
5. Paraquat + 2,4-D (2)	: Paraquat 0.4 + 2,4-D 1.0 Paraquat 0.6) 2,4-D 1.0
6. Unsprayed control	
No. of treatments	: 16+1 (unweeded control) : 17
Design	: RBD
Replication	: Three
Plot size	: 5 x 2 m

The herbicides were sprayed with an ASPEE back-pack sprayer fitted with a floodjet nozzle. The spray volume was about 500 litres/ha.

Observations were taken on the surviving plants one month after the application of the treatments.

Results:

The results of the experiment are given in Table 9. The treatments 2,4-DEE, 2.0 and 2.5 kg/ha, glyphosate 0.8 kg/ha and above doses, and paraquat 0.6 + 2,4-DEE 1.0 kg/ha (tank mix) were all statistically controlled by the treatment glyphosate 1.6 kg/ha. The results suggested that for a satisfactory control of Chromolaena odorata, 2,4-DEE 2.0 kg/ha, glyphosate 0.8 kg/ha, or paraquat 0.6 + 2,4-DEE 1.0 kg/ha are useful.

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2. Evaluation of post emergence herbicides for controlling Pennisetum polystachyon

Pennisetum polystachyon a troublesome perennial grass weed of plantation crops especially in its younger stages. It is usually seen in young rubber gardens, cashew gardens and coconut gardens. The present experiment was undertaken to find out the most effective herbicide and its dose for the post-emergence control of this perennial grass weed.

Technical programme

Herbicides	<u>dose kg/ha</u>
1. Paraquat	0.4, 0.8, 1.2
2. Dalapon	2.0, 4.0, 6.0
3. Glyphosate	0.4, 0.8, 1.2
4. Paraquat + Diuron	0.4 + 1.0 (tank mix)
	0.4 + 2.0 (, ,)
	0.8 + 1.0 (, ,)

Table 9) Effect of post-emergence herbicides on control of Chromolaena odorata

Herbicide kg/ha	No surviving plants/10m ² 1990	Dry weigh. of survived plants g/10m ²
Paraquat 0.4	5.81 (32.6)	5.39 (32.07)
Paraquat 0.6	5.12 (25.5)	7.23 (51.80)
Paraquat 0.8	4.93 (23.6)	7.27 (52.07)
Paraquat 1.0	3.87 (14.1)	6.69 (44.23)
2,4-D 1.0	4.12 (17.2)	2.12 (4.20)
2,4-D 1.5	3.82 (14.1)	1.00 (0.00)
2,4-D 2.0	1.28 (0.7)	1.00 (0.00)
2,4-D 2.5	1.14 (0.3)	1.00 (0.00)
Glyphosate 0.4	3.77 (13.9)	11.55 (133.0)
Glyphosate 0.8	1.58 (1.89)	8.22 (68.60)
Glyphosate 1.2	1.32 (0.9)	3.99 (15.40)
Glyphosate 1.6	1.00 (0.0)	1.21 (0.56)
Paraquat + Diuron 0.4 + 0.1	2.92 (8.4)	4.82 (22.40)
Paraquat + Diuron 0.6 + 1.0	2.95 (3.4)	3.55 (12.60)
Paraquat + 2,4-D 0.4 + 1.0	3.03 (8.4)	1.97 (2.94)
Paraquat + 2,4-D 0.6 + 1.0	2.03 (3.4)	2.11 (3.50)
Unsprayed control	8.15(66.0)	33.06 (1070.67)
SD (0.05)	1.28	1.22

* $\sqrt{x+1}$ transformed value

Values in the paranthesis are original values

5. Unweeded control

Number of treatments : $4 \times 3 = 12$ + unweeded control
Design : RBD
Replication : Three

Pennisetum polystachyon was established in the experimental field by means of vegetative method. Pennisetum setts collected were raised on beds of 2m x 2m. The herbicides were sprayed just before flowering. After one month of application of treatments observations were taken.

Results:

The number of surviving plants and their dry weight observed after one month of spraying is presented in Table 10

Among the herbicides tried excepting glyphosate 0.4 kg/ha, all others gave significantly better control. However, superior treatments were all combinations of paraquat and diuron and glyphosate 1.2. In the case of paraquat and glyphosate, there is an increasing trend of control, when the doses were increased. The experiment suggested that for the post-emergent control of Pennisetum polystachyon glyphosate 1.2 kg/ha and paraquat 0.4 kg + Diuron 1.0 kg/ha are effective.

3. Control of Eleocharis sp. with herbicides

Eleocharis sp is a common troublesome weed in the low lying aquatic areas of Kerala. In rice fields of Pokkali and Kayal land it competes with rice and reduces the yield considerably. Because of the serious problems from this weed, rice cultivation has been abandoned in some areas.

Table - 10 Evaluation of post-emergence herbicides for controlling Pennisetum polystachyon
No. of plants surviving and their dry weight

Treatments	No. of plants surviving per m ²	Dry weight g/m ²
Paraquat 0.4 kg/ha	11.83	1388.67 (37.055)*
,, 0.8 ,,	5.92	1008.67 (31.613)
,, 1.2 ,,	6.17	591.00 (24.213)
Dalapon 2 kg/ha	9.42	1282.67 (35.808)
,, 4 ,,	11.67	1063.00 (32.318)
,, 6 ,,	8.84	836.3 (28.549)
Glyphosate 0.4 kg/ha	10.75	2705.00 (52.000)
,, 0.8 ,,	8.92	1455.00 (38.029)
,, 1.2 ,,	3.75	237.67 (18.163)
Paraquat 0.4 kg + Diuron 1 kg/ha	3.92	347.67 (18.163)
,, 0.4 kg + ,, 2kg/ha	5.50	490.00 (17.981)
,, 0.8 kg + ,, 1kg/ha	4.33	502.00 (20.592)
Unsprayed	13.08	2504.67 (49.742)
SEm ₊	1.6703	4.0866
CD (0.05)	4.8756	11.9285

* \sqrt{x} Transformed value

A trial was planned to evaluate different herbicides to control this weed as an alternative to manual removal which is highly time consuming and costly.

Technical programme:

1. Glyphosate 0.8 kg/ha
2. Glyphosate 1.6 kg/ha
3. Glyphosate 2.4 kg/ha
4. Glyphosate 0.8 kg/ha as a spray with ammonium sulphate 0.5%
5. Glyphosate 1.6 kg/ha ,,
6. Glyphosate 2.4 kg/ha ,,
7. 2,4-D 2.0 kg/ha ,,
8. 2,4-D 3.0 kg/ha ,,
9. 2,4-D 4.0 kg/ha ,,
10. 2,4-D + Paraquat 2.0 + 0.5 kg/ha (tank mix)
11. 2,4-D + Paraquat 3.0 + 0.5 kg/ha (tank mix)
12. 2,4-D + Paraquat 4.0 + 0.5 kg/ha (tank mix)
13. Control

Total number of treatments : 13

Plot size : 10 x 5 m²

Design : RBD

Replications : 3

The experiment was laid out at the abandoned paddy fields of Regional Agricultural Research Station, Kumarakon which was infested with Eleocharis.

The herbicides were sprayed after demarkating the boundaries with a hydraulic sprayer fitted with floodjet nozzle, using 500 litres of spray fluid/ha.

Results:

Observations taken on the survived plants and dry weight after two months of application of treatment are presented in Table 11

Table 11 Effect of herbicides on the survival and dry weight of Eleocharis (two months after herbicide application)

Treatments	Number of surviving shoots/m ²	Dry weight of surviving shoots g/m ²
Glyphosate 0.8 kg/ha	631.67(24.683)	76.0 (8.461)*
„ 1.6 „	92.00(9.633)	15.0 (3.984)
„ 2.4 „	18.00(3.945)	2.67 (1.865)
Glyphosate 0.8 kg/ha + AS 0.5%	74.67(8.673)	8.00 (2.937)
„ 1.6 „	68.00(6.273)	10.00 (3.231)
„ 2.4 „	30.00(5.552)	5.33 (2.515)
2,4-D 1.0kg/ha	199.67(13.976)	22.67 (4.746)
„ 2.0 „	0.00(1.000)	0.00 (1.000)
„ 3.0 „	0.00(1.000)	0.00 (1.000)
„ 4.0 „	0.00(1.000)	0.00 (1.000)
2,4-D + Paraquat 1.0 + 0.5 kg/ha	280.67(16.671)	25.33(5.086)
„ 2.0 + 0.5 „	340.00(18.268)	36.67(6.104)
„ 3.0 + 0.5 „	129.67(11.302)	13.00(3.722)
„ 4.0 + 0.5 „	59.33(7.765)	5.33(2.515)
Unsprayed control	833.33(28.864)	100.67(10.065)
SEm _±	1.2796	0.5345
SD (0.05)	3.7062	1.5480

* $\sqrt{x + 1}$ transformed values

Among the various herbicides tried 2,4-D ethylester gave satisfactory control. 2,4-DEE 2.0 kg/ha and above gave complete control of the weed without any regrowth. Other herbicides such as glyphosate or 2,4-D + Paraquat combination were not as much effective as that of 2,4-DEE alone. Between glyphosate alone and glyphosate with 0.5% Ammonium sulphate, the latter was significantly superior. When glyphosate was tried alone its higher dose ie. 2.4 kg/ha was the superior treatment. However, when glyphosate was mixed with ammonium sulphate even 0.8 kg/ha gave a control on par with glyphosate alone @ 2.4 kg/ha. The results of the experiment clearly indicate the possibility of using 2,4-DEE at 2.0 kg/ha for the control of Eleocharis sp in rice fields.

IV. EFFICIENCY OF HERBICIDE USE

Effect of adjuvants on the efficiency of Glyphosate

Glyphosate has been found to be an efficient herbicide against most of the weeds especially perennial grass weeds growing in the plantation crops. However the high cost of the chemical stands in the way of large scale adoption. There are some indications that some adjuvants can increase the efficiency of this herbicide, thereby reducing the dose required. Hence a study was conducted to evaluate some of the common adjuvants to enhance the efficiency of glyphosate.

Technical programme

Pennisetum pedicellatum, a troublesome grassy weed in the plantation crops was taken as the test plant. Seeds of the grass were collected and uniform quantity sown in plots of 2x2m size. The treatments were applied on the plants at 2 month's stage.

Treatments

T ₁	-	Glyphosate	0.4 kg/ha
T ₂	-	,,	0.6 ,,
T ₃	-	,,	0.8 ,,
T ₄	-	,,	0.4 + Urea 3%
T ₅	-	,,	0.6 + ,,
T ₆	-	,,	0.8 + ,,
T ₇	-	,,	0.4 + Kaolin clay (2.5 kg/ha)
T ₈	-	,,	0.6 + ,, ,,
T ₉	-	,,	0.8 + ,, ,,
T ₁₀	-	,,	0.4 + Triton A.E.(450 ml/ha)
T ₁₁	-	,,	0.6 + ,, ,,
T ₁₂	-	,,	0.8 + ,, ,,
T ₁₃	-	,,	0.4 + Ammonium sulphate (0.5%)
T ₁₄	-	,,	0.6 + ,, ,,
T ₁₅	-	,,	0.8 + ,, ,,

- T₁₆ - Glyphosate 0.4 + Sandowit (300 ml/ha)
- T₁₇ - " 0.6 + " "
- T₁₈ - " 0.8 + " "
- T₁₉ - Unsprayed check
- T₂₀ - Glyphosate 1.0 kg/ha alone
- T₂₁ - " 1.2 kg/ha alone
- Design - RBD

Replication- 2

The results revealed that all the levels of glyphosate with 0.5% Ammonium sulphate and glyphosate 0.8 kg/ha + Urea 3% and glyphosate alone at 1.2 kg/ha were comparable giving lower values for weed drymatter. The efficiency of glyphosate, this could be increased by combining with 0.5% Ammonium sulphate or 3% Urea. (Table 12)

Method of application of pre-emergence herbicides in direct sown puddled rice.

In direct sown puddled rice, application of herbicides by spraying is not easy due to the peculiar field conditions. In such situations granular formulations of herbicides are more convenient for uniform application. In this back ground an experiment was undertaken in 1990 Kharif to compare herbicide spraying and sand mixed broadcasting in direct sown puddled rice.

Technical programme

Treatments:

Oxyflourfen	0.1 kg/ha	Spray and sand mix
Thiobencarb	1.5 kg/ha	-do-
Butachlor	1.5 kg/ha	-do-
Anilophos	0.3 kg/ha	-do-
Pendimethalin	1.0 kg/ha	-do-
Pretilachlor	1.0 kg/ha	-do-
Unweeded control		
Hand weeding		
Total number of treatments	= 6x2+2 =14	
Replication	- 3	
Design	- RBD	

The herbicides were sprayed in water or broadcasted by sand mixing on sixth day after sowing sprouted seeds.

Table 12. Effect of adjuvants on the efficiency of glyphosate (Observations taken one month after treatment)

Treatments	No. of hills surviving/plot		Dry weight/plot	
	1990		1990	
	T	O	T	O
Unsprayed check	6.29	38.63	32.01	1028.75
2 Glyphosate 0.4+Urea 3%	3.42	11.13	19.72	393.80
3 Glyphosate 0.6+Urea 3%	1.75	2.25	8.94	129.9
4 Glyphosate 0.8+Urea 3%	1.11	0.25	2.65	8.8
5 Gly.0.4+Kaolin(2.5kg/ha)	4.48	21.38	19.30	403.8
6 Gly.0.6+Kaolin(2.5kg/ha)	5.49	30.25	33.68	1142.5
7 Gly.0.8+Kaolin(2.5kg/ha)	4.51	19.88	20.98	442.5
8 Gly.0.4+Triton L.E. 450ml/ha	5.13	26.63	28.59	833.8
9 Gly.0.6+ , ,	4.36	21.13	16.25	273.8
10 Gly.0.8+ , ,	3.16	9.00	12.48	168.9
11 Gly.0.4+Am.Sulphate(0.51)	1.67	2.25	3.70	20.0
12 Gly.0.6+ , ,	1.65	2.13	3.89	22.5
13 Gly.0.8+ , ,	1.33	0.90	3.50	17.5
14 Gly.0.4+Sandowit 300 ml/ha	4.86	23.25	21.83	503.8
15 Gly.0.6+ , ,	3.33	10.15	14.68	218.8
16 Gly.0.8+ , ,	3.91	15.63	21.68	477.8
17 Gly.0.4 alone	6.45	40.63	27.49	756.8
18 Gly.0.6 alone	6.51	41.50	27.94	789.8
19 Gly.0.8 alone	3.54	11.63	17.51	306.8
20 Gly.1.0 alone	3.84	13.88	11.94	153.8
21 Gly.1.2 alone	1.65	1.75	6.15	37.6
CD (0.05)	1.82		10.01	

T - $\sqrt{x+1}$ transformed value

O - Original value

Results

The results of the experiment is presented in Table 13. Application of different pre-emergence herbicides at 6 DAS resulted in significant weed control as well as increased yield of rice. There was not much difference in the yield of rice due to application of the herbicide as spray or sand mix broadcasting, except for Oxyfluorfen which resulted in higher yields when applied as sand-mixed broadcasting. When sprayed, Oxyfluorfen resulted in phytotoxicity to crop seedlings. In general the dry matter production of weeds was lesser in plots where the herbicides were applied as spray (Table 13)

OBSERVATIONAL TRIALS

Observational trial for the weed control in Pokkali rice

The pokkali lands comprise of the marshy area of Ernakulam and Alappuzha districts in Kerala. The area is highly saline and acidic. Here only one crop is taken during kharif season and the rest of the period is used for prawn cultivation. The salinity tolerant rice grown in kharif with special cultivation practices to prevent salinity is popularly called Pokkali rice. Since the land is under saline water for most of the time, the weed problems and also the problems of weed control encountered in these areas are different from fresh water areas. The spectrum of weed flora is quite narrow. However, Diplachne fusca - a grassy weed and Eleocharis sp a perennial sedge poses severe problems to the crop.

Because of the peculiar ecological conditions prevailing in the fields and also because of the nature of major weeds, usual weed management practices followed in rice field, are difficult to apply here. Hence, an observational trial was planned in a farmer's field to evaluate the efficiency of different pre-emergence

Table 13. Effect of method of application of pre-emergence herbicides and yield of wet-sown rice

Treatments	Yield kg/ha	No. of weeds/m ²	Dry weight of weeds/t
Oxyflourfen 0.1 kg/ha - spray	1900	52 (7.080)*	29 (5.458)
Oxyflourfen 0.1 kg/ha - sand mix	2650	30 (4.893)	30 (5.495)
Fluobencarb 1.5 kg/ha - spray	2530	86 (9.090)	42 (6.555)
Fluobencarb 1.5 kg/ha - sand mix	2590	55 (6.623)	80 (8.911)
Butachlor 1.5 kg/ha - spray	2759	38 (4.887)	4 (2.000)
Butachlor 1.5 kg/ha - sand mix	2640	26 (4.140)	5 (2.158)
Anilophos 0.3 kg/ha - spray	2130	19 (2.791)	28 (4.275)
Anilophos 0.3 kg/ha - sand mix	2210	38 (5.967)	56 (7.474)
Pendimethalin 1.0 kg/ha - spray	2290	58 (7.482)	22 (4.754)
Pendimethalin 1.0 kg/ha - sand mix	2190	54 (6.727)	102 (10.125)
Pretilachlor 1.0 kg/ha - spray	2090	26 (4.618)	82 (9.075)
Pretilachlor 1.0 kg/ha - sand mix	2094	4 (2.000)	74 (6.603)
Hand weeded	3130	56 (7.507)	14 (3.86)
Unweeded	11276	152 (12.368)	168 (12.6)
SEM	106.73	NS	1.8394
CD (0.05)	326.02	NS	5.6187

* $\sqrt{x+1}$ transformed values

herbicides against Diplachne fusca, the grassy weed.

In order to control Eleocharis, 2,4-DEE was also included in the treatment. The treatments included were:

1. Butachlor 1.5 kg/ha
2. Thiobencarb 1.5 kg/ha
3. Penoxalin 1.5 kg/ha
4. Pretilachlor 0.5 kg/ha
5. Oxyflourfen 0.1 kg/ha
6. Unsprayed control
7. Hand weeding (weedy check)

The experiment was laid out in RBD with four replications. The plot size was 4x5 m.

Pre-emergence herbicides were sprayed one week after dismantling the mounds and transplanting the seedlings. 2,4-D was sprayed one month after transplanting. Observations were taken on the surviving weeds and grain yield and straw yield of the crop. The results of the experiment is presented in Table 14. The results showed that all the pre-emergence herbicides were effective in reducing the population of Diplachne fusca compared to the unweeded control. 2,4-D application was also found to be effective for controlling Eleocharis. Maximum grain yield was obtained in Oxyfluorfen 0.1 kg, Butachlor 2.0 kg and pretilachlor 0.5 kg/ha as pre-emergence spray each followed by 2,4-D 1.0 kg/ha as post-emergence.

Table 14 Effect of herbicides on the population of Diplachne fusca and yield in pokkali rice.

Treatments	Number of <u>Diplachne</u> plants ² per m ²	Grain yield kg/ha.	Straw yield kg/ha
1. Butachlor 2.0 kg/ha.	28	37.41	53.12
2. Thiobencarb 2.0 kg/ha.	20	24.65	40.55
3. Oxyfluorfen 0.1 kg/ha.	4	37.41	34.35
4. Penoxalin 1.5 kg/ha	40	28.06	34.18
5. Pretilachlor 0.5 kg/ha.	32	37.41	35.20
6. Unweeded control	120	22.95	20.75
7. Hand weeding	---	19.55	39.54

Publications

1. Ecological survey of weeds in the rice ecosystem of Kuttanadu.

Abraham, C.T., Joseph, P.A. and George Thomas, C. Presented in the National Symposium of Rice in wet land Ecosystem, held at Kottayam on 19-21 December 1990.

2. Chemical control of Parthenium.

Abraham, C.T., Joseph, P.A. and George Thomas, C. Presented at the Kerala Science Congress on 28.2.91 to 3.3.91 at Calicut.

Extension activities

Scientists of the project are associated with the extension activities of Kerala Agricultural University. Advices on weed management to farmers are offered whenever contacted. Farmers field trials are conducted at Kuzhuppilly (Ernakulam District) on weed control in Pokkali rice and at Chavakkad (Trichur District) on the control of Eichhornia crassopes.

A three day training programme on "Herbicide use in rice cultivation" was conducted from 8-10th August 1990 at the Central Training Institute Mannuthy. Twenty two Assistant Directors from the Department of Agriculture, Kerala, participated in the training.

AICRP ON WEED CONTROL

KERALA AGRICULTURAL UNIVERSITY

THRISSUR - 680 654

PROPOSED TECHNICAL PROGRAMME FOR 1991-92

I. Survey of weed flora

To be continued in two new agro-climatic zones not yet covered.

II. Biology and control of problem weeds

A. Biology : Under this the biology of the following weeds will be studied.

1. Chromolaena odorata
2. Pennisetum spp (P. pedicellatum & P. polystachyon)
3. Saccollepis interrupta

Technical programme

Observations will be made on

1. Time of germination in the natural conditions
2. Habitat
3. Life span
4. Flowering and seed production
5. Methods of seed dispersal
6. Dormancy
7. Ability of the plant to propagate by
 1. Seed
 2. Stem (at different ages)
 3. Root cuttings, will be studied under different soil conditions (depth of planting, moisture level etc.)

B. Control of problem weeds

1) Effect of different forms of 2,4-D on Chromolaena odorata

Treatments : 16

1.	2, 4-D Na	-	1.0 kg/ha
2.	-do-	-	1.5 kg/ha
3.	-do-	-	2.0 kg/ha
4.	-do-	-	2-5 kg/ha
5.	-do-	-	3.0 kg/ha
6.	2,4-D Ethyl ester	-	1.0 kg/ha
7.	-do-	-	1.5 kg/ha
8.	-do-	-	2.0 kg/ha
9.	-do-	-	2.5 kg/ha
10.	-do-	-	3.0 kg/ha
11.	2,4-D Amine	-	1.0 kg/ha
12.	-do-	-	1.5 kg/ha
13.	-do-	-	2.0 kg/ha
14.	-do-	-	2.5 kg/ha
15.	-do-	-	3.0 kg/ha
16.	Unsprayed control		

Design : R.B.D. Replication : 3

2) Effect of pre-emergence herbicides on Saccolipsis interrupta

The following pre-emergence herbicides will be evaluated for their effect on Saccolipsis

Thiobencarb (2)	1.0 & 2.0 kg/ha
Eutachlor (2)	1.0 & 2.0 kg/ha
Pendimethalin (2)	1.0 & 2.0 kg/ha
Oxyfluorfen (2)	0.1 & 0.2 kg/ha
Pretilachlor (2)	0.5 & 1.0 kg/ha
Anilophos (2)	0.3 & 0.6 kg/ha

Unweeded control

Hand weeding

No. of treatments : 14

Design : RBD

Plot size : 2 x 2 m².

Seeds of the weed will be broadcast in the plots (uniform quantity), to ensure uniform population

Observations

1. No. of Saccolipsis established
2. Dry matter production
3. Phytotoxicity symptoms

3) Control of Pennisetum polystachyon

Treatments

Paraquat	0.4 kg, 0.8 kg, 1.2 kg/ha
Dalapon	2.0 kg, 4.0 kg, 6.0 kg/ha
Glyphosate	0.4 kg, 0.8 kg, 1.2 kg/ha
Glyphosate with Am-SO ₄ (0.5%)	
Paraquat + Diuron	0.4 + 1.0 kg/ha
-do-	0.8 + 1.0 kg/ha
-do-	0.4 + 0.2 kg/ha
Unsprayed control	
No. of treatments	16
Design	R.B.D.
Plot size	2 x 2 m ²

Pennisetum plants will be uniformly planted in all the plots. Herbicide application will be done just before flowering.

4) Control of Eleocharis dulcis

Treatments

1. 2,4-D Na 2.0 kg
2. 2,4-D Na 3.0 kg
3. 2,4-D ethyl ester 2.0 kg
4. 2,4-D ethyl ester 3.0 kg

5. 2,4-D Amine 2.0 kg
6. 2,4-D Amine 3.0 kg
7. Glyphosate 0.8 kg
8. Glyphosate 1.2 kg
9. Glyphosate 1.6 kg
10. Glyphosate 0.8 + 0.5% Am. Sulphate
11. " 1.2 + 0.5% "
12. " 1.6 + 0.5% "
13. Unsprayed control

Design : R.B.D.

Replications : 3

Plot size : 5 m x 5 m

Observations

1. No. of shoots surviving at 2 months after spraying
2. Dry weight of surviving shoots at 2 months after spraying.

III. Weed Management Research

5. Weed management in Cardomom gardens

Treatments

1. Unweeded control
2. Manually weeded control
3. Paraquat 0.4 kg/ha two sprays at 30 day interval
4. Paraquat 0.4 kg + Diuron 1.0 kg/ha (tank mix)
5. Glyphosate 0.8 kg/ha
6. Glyphosate 0.8 kg + Diuron 1.0 kg/ha (tank mix)
7. Glyphosate 0.8 kg + Atrazine 1.0 kg/ha (tank mix)
8. Dalapon 5.0 kg/ha + 2,4-D 1.0 kg/ha (tank mix) twice at 30 day interval.
9. Dalapon 3.0 kg/ha + 2,4-D 1.0 kg/ha (tank mix) twice at monthly interval
10. Glyphosate 1.2 kg/ha
11. Glyphosate 0.8 kg with Ammo. Sulphate 0.5%

Replication : 3 Design : R.B.D.

Location - I.C.R.I. farm Myladumpara. (Entire cost of operations will be met from ICRI.)

Observations

1. Phytotoxicity to crop
2. Weed count
3. Weed dry matter production

6. Weed management in coffee gardens

Treatments

1. Paraquat 0.4 kg/ha 3 sprays at monthly intervals
2. Paraquat 0.4 kg/ha + Diuron 1.0 kg/ha (tank mix)
3. Glyphosate 0.8 kg/ha
4. Glyphosate 1.2 kg/ha
5. Glyphosate 0.8 kg/ha + Diuron 1.0 kg/ha
6. Dalapon 3 kg/ha + 2,4-D kg/ha (tank mix) thrice at monthly intervals.
7. Dalapon 5 kg/ha + 2,4-D 1.0 kg/ha (tank mix) thrice at monthly intervals.
8. Sickle weeding (2, 3 times depending on weed growth - farmer's practice)
9. Unweeded control
10. Glyphosate 0.8 kg/ha + Amm. Sulphate 0.5 % in spray solution.

Design : R.B.D. Replication: 3
 Plot size : 40 m² (Approx.)

Observations

1. Weed count at intervals
2. Dry matter production at intervals
3. Shift in weed flora

7. Integrated weed management in sesame

Treatments

1. PPI - Alachlor 1.5 kg/ha + H.W (25 DAS)
2. " - Pendimethalin 1.0 "
3. " - Fluchloralin 1.0 "
4. " - Oxyfluorfen 0.1 "
5. " - Metolachlor 1.0 "
6. Pre-em. - Alaachlor 1.5 kg "
7. " - Pendimethalin 1.0 "
8. " - Fluchloralin 1.0 "
9. " - Oxyfluorfen 0.1 "
10. " - Metolachlor 1.0 "

- 11. Inter cultivations at 15 & 30 DAS
- 12. Unweeded control

Design : R.B.D. Replication : 3

Observations:

- 1. Weed population (Species wise) and Dry matter production
 - 2. Crop yield and yield attributes
 - 3. Phytotoxicity symptoms.
8. Influence of herbicide combinations on the growth and yield of transplanted rice.

Treatments.

- 1. Anilophos 0.4 kg/ha
- 2. Butachlor 1.25 kg/ha
- 3. 2,4 DEE 1.0 kg/ha
- 4. Anilophos 0.3 + 2,4-DEE 0.4 kg/ha
- 5. Butachlor 0.75 + 2,4-DEE 0.4 kg/ha
- 6. Anilophos 2,4-DEE ready mix
(Anilophos 24% + 2,4-DEE 32% - 1000ml/ha)
- 7. Anilophos : 2,4-DEE ready mix - 1500 ml/ha.
- 8. Napro anilide 1.5 kg/ha
- 9. Napro anilide 2.0 kg/ha
- 10. Hand weeding twice at 20 and 40 DAT.
- 11. Unweeded control.

All the herbicides will be applied as pre-emergence at 7 DAT cultivar - Jyothi Design:RBD
Replications : 3-

Observations

- 1. Weed study : Weed flora, weed density and weed dry matter.
- 2. Crop study : Phytotoxicity symptoms, dry matter production, yield attributes and grain yield.

IV. Studies on alternation in methods of herbicide application techniques.

- 9. Effectiveness and crop-selectivity of pre-emergence herbicides under different methods of application in puddled rice.

Treatments

- | | | |
|-----|-------------------------------|------------|
| 1. | Oxyflourfen 0.1 kg/ha | - spray |
| 2. | -do- | - sand mix |
| 3. | Thiobencarb 1.5 kg/ha | - spray |
| 4. | -do- | - sand mix |
| 5. | Butachlor 1.5 kg/ha | - spray |
| 6. | -do- | - sand mix |
| 7. | Anilophos 0.4 kg/ha | - spray |
| 8. | -do- | - sand mix |
| 9. | Pendimethalin 1.0 kg/ha | - spray |
| 10. | -do- | - sand mix |
| 11. | Pretilachlor 1.0 kg/ha | - spray |
| 12. | -do- | - sand mix |
| 13. | Hand weeding - 20 and 35 DAS- | |
| 14. | Unweeded control | |

Design : R.B.D.

Replication : Three

Observations

1. Phytotoxicity symptoms on crop seedlings
2. No. of weeds - at different stages
3. Weed dry matter production at different stages
4. Yield of the crop

V. On-Farm Trials

Crop : Rubber

Treatments

1. Paraquat 0.4 kg/ha Three sprays at monthly interval
2. Glyphosate 0.8 kg with 0.5% Am. Sulphate
3. Cover crop - Peuraria sp.

Meteorological data at Vellanikkara
during 1990

Month	Mean max. Temp. °C	Mean mini. Temp. °C	Mean R.H. (%)	Rain fall (mm)	Rainy days	Eva- pora- tion (mm)	Mean sun- shine hrs
January	33.5	20.8	50	3.5	0	222.0	19.0
February	34.9	21.9	58	0	0	210.6	10.0
March	36.0	23.8	64	4.4	1	213.7	9.7
April	35.8	25.4	68	38.8	2	189.8	8.3
May	31.5	24.1	82	583.9	18	109.5	4.5
June	29.7	23.3	85	467.3	25	84.3	3.4
July	28.4	22.5	88	759.3	28	79.1	2.4
August	29.0	23.0	85	356.4	22	90.4	3.5
September	30.7	23.4	79	87.5	8	101.0	6.2
October	31.9	23.2	80	313.3	12	109.9	6.5
November	31.2	22.6	74	69.8	3	101.7	6.0
December	32.3	23.1	59	1.8	0	184.5	10.2

SUMMARY OF THE PROGRESS REPORT FOR 1990 - 91.

I. Survey of weed flora.

The survey of weeds was conducted in the Central zone of Kerala.

In the rice fields Echinochloa colona, E. crusgalli, Saccolipsis interrupta and Isachne miliacea were the major grassy weeds. Among sedges, Cyperus difformis, Cyperus iria, Scirpus supines and Cyperus haspan were important. Among broad leaf weeds, Monochoria vaginalis, Ludwigia perennis etc. were the predominant weeds. Marsilia quadrifoliata and Eriocaulon spp were also seen in many places.

In coconut gardens, the major grassy weeds were Ischaemum spp, Digitaria spp, Pennisetum spp and Oplismenus spp. Borreria spp, Synedrilla nodiflora, Leucas aspera etc. were the predominant dicot weeds. There was great diversity in the weed flora seen in coconut gardens.

In young rubber gardens, where cover crops are grown weed problems are very less. However, where cover crops are not raised, the major weeds were Pennisetum spp, Chromolaena odorata, Synedrilla nodiflora and Ischaemum spp. In mature rubber gardens, in general weed problems are less.

In arecanut gardens, the major weeds were Oplismenus spp, Dactyloctenium aegyptium, Desmodium trifolium, Biophytum sensitivum etc.

In cassava, Digitaria spp, Alloteropsis cimicina (grasses) Borreria spp, Synedrilla nodiflora, Ageratum conyzoides, Leucas aspera (Broad leaf weeds) and Cyperus distans (sedge) were common.

In banana gardens, the major weeds were Ischaemum spp, Alloteropsis cimicina, Digitaria ciliaris, Borreia spp. Leucas aspera, Ageraum conyzoides and Verngnia cineria.

II. Integrated Weed control in specific crops.

1. Weed management in coffee gardens.

The experiment revealed that for reasonable weed control in coffee gardens, spraying dalapon 3 kg + 2,4-DEE

0.5 kg/ha twice at monthly intervals or paraquat 0.4 kg/ha twice at monthly intervals are effective.

2. Weed management in Cardamom plantation.

Preliminary investigations on the control of weeds in cardamom indicated that spraying paraquat 0.4 kg/ha at bimonthly intervals is sufficient for the control of weeds.

III. Studies on the control of problem weeds.

1. Control of chromolaena odorata with post-emergence application of herbicides.

For the post-emergent control of the Weed Chromolaena odorata frequently seen in plantation crops, application of 2,4-DEE 2.0 kg/ha or glyphosate 0.8 kg/ha are effective.

2. Evaluation of post-emergence herbicides for controlling Pennisetum polystachyon.

The experiment suggested that for the post-emergent control of Pennisetum polystachyon glyphosate 1.2 kg/ha and paraquat 0.4 + Diuron 1.0 kg/ha are effective.

3. Control of Eleocharis sp. with herbicides.

For the post-emergent control of Eleocharis sp. a perennial aquatic weed in flooded rice fields, 2-4-DEE at 2.0 kg/ha was found to be promising.

IV. Efficiency of herbicide use

1. Effect of adjuvants on the efficiency of glyphosate.

The studies conducted to increase the efficiency of glyphosate revealed that its efficiency at lower doses can be increased by more than 50 per cent by spraying with 0.5 % ammonium sulphate solution or by spraying with 3% urea. Glyphosate alone at 1.2 kg/ha, glyphosate 0.4 kg + 0.5% Ammonium sulphate, and glyphosate 0.6 kg + 3% urea were similar in action on the control of Pennisetum pedicellatum, the test weed.

2. Methods of application of pre-emergence herbicides in direct sown puddled rice.

The method of herbicide application was significant only in the case of Oxyfluorfen 0.1 kg/ha. Sand mixing gave a higher yield than spray. However, in the case of all other herbicides effects were almost same whether applied as spray or sand mixed broad casting.

V. Observational trials.

Observational trial for the weed control in Pokkali rice.

The experiment conducted in the farmers field to evaluate the efficiency of different herbicide combinations in the salinity affected Pokkali rice fields indicated that the treatments Oxyfluorfen 1.0 kg; Butachlor 2.0 kg. and Pretilachlor 0.5 kg/ha as pre-emergence spray each followed by 2,4-D 1.0 kg/ha were comparable in reducing the weed population and giving better yields.

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