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Weed shift by long term use of dinitroaniline herbicides and glyphosate in cotton

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Abstract
Adoption of chemical based weed control for crop cultivation has been one of the most important revolutions in the history of agriculture. In certain regions application of non-selective glyphosate is commonly followed since many years under crop situation by farmers by physically covering the plants. Weed survey was conducted in mono cropped cotton farm to find out weed shift. The survey was conducted at CICR Farm, Coimbatore (Tamil Nadu) to assess continuous use of pendimethalin and Rasipuram (Salem Dt, Tamil Nadu) and Namakiripettai (Namakkal DT, Tamil Nadu) to assess intensively glyphosate used farms during the year of 2013-2014. The farm had adopted manual weeding for weed control, was kept as control plot.

Weed analysis carried out in cotton field applied with dinitroaniline for more than 30 years revealed that *Trianthema portulacastrum* (Itsit) is the major one (RD, 40.5%), (RF, 18.5 %), (IV, 59.0) and (SDR, 29.5)). It is closely followed by *Cyperus rotundus* (Motha) (with 35.5 % RD, 23.0 % RF, 58.6 IV and 29.3 SDR). On the contrary, control plots is infested with dominant species of *Panicum repens* with RD of 46.4 %, RF of 20.76 %, IV of 67.1 and SDR of 33.5. Thus, over the years, weed species has shifted from grassy weeds to broad leaved & sedges by application of pendimethalin. Pot culture experiment was carried out by using the seed materials of *Trianthema portulacastrum* collected from the continuous herbicide applied and control field and tested with different levels of pendimethalin (0, 0.55, 1.0, 2.0 and 3 kg/ha) to assess weed control efficiency. The results were nor varied between continuous herbicide applied field and control field. Hence the study concluded that the dominance of *Trianthema portulacastrum* under the specific situation is more probably due to *weed* shift and there is no evidence for development of resistance to pendimethalin.

Absolute weed density of 429.8 and 279/m^2 were counted in control plot respectively at Rasipuram and Namakiripettai. *Echinochloa colona* was the predominant and observed with absolute density of 369.8/ m^2, relative density of 86.1 per cent, important value index of 109.2 and summed dominance ratio of 54.6 in control plot at Rasipuram. The same species was pre dominant species in Namakiripettai also found with absolute density of 64.0/ m^2, relative density of 22.9 per cent, important value index of 31.8 and summed dominance ratio of 15.9 in control plot. Intensive glyphosate used farms (more than 20 years) were surveyed revealed that weed population was significantly reduced and reached the absolute density of 12.0 and 19.1/ m^2 respectively at Rasipuram and Namakiripettai. In glyphosate used farm *Cyperus rotundus* was predominant (60.78 per cent) followed by *Commelina benghalensis* (21.57 per cent) at Rasipuram. In Namakiripettai, *Cyanotis cucullata* recorded the highest relative density of 31.4 % and *followed by Cyperus rotundus* (*relative* density of 24.2%) in glyphosate applied plots. Thus, over the years weed species shifted from grasses to sedges and broad leaved weeds by continuous use of glyphosate.

Keywords: weed shift, herbicides, dinitrianiline, glyphosate, cotton

Introduction
A weed shift is the change in the composition or relative frequencies of weed in a weed population or community in response to natural or manmade environmental changes in an agricultural system. Many factors play possible role in weed shift. Species which have same ecological demands are inclined to occupy the same habitats with much rapidity. The weed control measures and environmental factors have a significant influence on the intensity and infestation of weeds (Saavedra *et al.*, 1990) [15]**.** Labour scarcity at critical stages of weed competition, higher wages and short time available to complete the weeding operation because of incessant rains during early part of cotton crop is not uncommon one. Thus, herbicides are considered to be an alternatives to hand weeding (Singh *et al*., 2007) [17]. Dinitroaniline based chemicals includes fluchloralin and pendimethalin are recommended pre emergence weedicides for cotton. Glyphosate is effective, broad spectrum, non-selective and cheaper

chemicals; which is used by farmers in certain regions for different crops including cotton by adopting indigenous methods to attain selectivity. Steinmann *et al*., (2012) [18]. Reported that glyphosate offers large benefits to farmers. Enormous farm specific and nation-wide value due to glyphosate use was reported by Cook *et al*., (2010) [5]. The continuous use of chemicals for weeding may interfere with population dynamics and leads to weed shift. Changes in a weed distribution can provide critical information regarding the weed species expansion or contraction, predictability of occurrence, effectiveness of control measures, habitat preferences and dispersal mechanisms. The present survey was planned to study the abundance, distribution and diversity of weed flora in cotton crop adopted long term use of dinitro aniline and glyphosate based weed control

Material & Methods

Abundance measures the quantitative significance of a species in its habitat. It describes the success of weed in terms of numbers. Density and frequency are the two simplest and most popular methods of measuring abundance.

Dinitroaniline based weed shift

Weed survey was conducted at experimental farm of Central Institute for Cotton Research, (CICR) Coimbatore in 2013 to assess weed shift by continuous application of dinitroaniline based weedicides. In CICR farm, where cotton is under cultivation since many years.Application of fluchloralin @ 0.75 kg a.i./ha (Basalin) as pre-plant followed by irrigation is the common practice of early season weed control followed by manual weeding & interculture by junior hoe at 45-50 days. Recently the chemical is unavailable in the market; which was replaced by pendimethalin @ 1 kg ai/ha. The Dinitroaniline based weed control was followed in the farm for last thirty years. The fields, where chemical weeding is not followed for weed control had treated as control plot and survey was made for comparison.

Glyphosate based weed shift

The sample area was Rasipuram taluke of Salem District includes villages of, Thoppapatti, Singlandhapuram, Chellampatti and Kadirinallur and Namakkal District includes villages of Jadapalayam Pachudipalayam, Velampalayam, Oduvankurichi and Namagiripettai were surveyed for identification of weed shift in continuous use of glyphosate in cotton based cropping system in 2013. Cotton, Turmeric, Tapioca and Banana, are the major crops being cultivated in these domain. Mono-cropping of cotton is practiced by 45 per cent of farmers, 25 per cent adopt Cotton- Turmeric and Cotton-Tapioca and banana was followed by 10 per cent of farmers. Nearly 85 per cent of farmers cultivate ELS cotton with genotype of MRC 7918. The average land holding size of farmers is 6.4 acres and cotton is cultivated in an area of 3.7 acres. Glyphosate used in nearly by 95 per cent of farmers. Glyphosate is used for all four crops of cotton, turmeric, tapioca and banana for weed control.

Method of application of glyphosate

Weeds germinated by pre monsoon rainfall are controlled by glyphosate without any protected cover under non-crop situation. In crop situation, novel method of indigenous technique is followed for glyphosate application. The seedlings of cotton and stem cutting of tapioca is covered by long necked aluminum glass, subsequently chemical is applied without using protective shield. Glyphosate is applied for weed control before germination of turmeric rhizome in turmeric field.The protected shield is used for spraying of glyphosate for weed control in established crop of cotton, turmeric, tapioca and banana. The farmer's interaction revealed that dose of 85-150 ml of glycel (Glyphosate product Excel Industries Ltd) used for tank (12 litres capacity) of water, and requires in an average of 15-20 tanks to cover an acre of land; which is equivalent to using of 1.4 - 3.1 kg ai/ha of glyphosate per spraying. Seventy percent of farmers had accepted that quantity of chemical required is increased (75,100,125 and 150 ml / tank) from initial year to achieve the effective control of weeds.

To study the floristic composition of weeds in glyphosate used farms of Salem and Namakkal Districts of Tamil Nadu 50 fields were surveyed during cotton season of 2013 and 2014. This period of survey depicts most appropriate one at initial crop growth stages. The observations on density of individual weeds were recorded per field at one spot by using quadrate of 0.5 x 0.5 m, 100 meters deep inside the fields. Pooled average values of observations of absolute density (AD) relative density (RD),occurrence, absolute frequency (AF), relative frequency (RF), importance value index (IVI) and summed dominance ratio (SDR) of individual weeds were calculated as per method suggested by Misra (1968) [11]. And Raju (1977) [14].

Results and Discussion

Weed flora composition significantly diverged among districts due to different cropping systems, soil types, rainfall amount, fertility status, irrigation facilities and quality of underground water in addition to other agronomic practices.

Dinitroaniline based weed control

Weed survey was conducted at experimental farm of Central Institute for Cotton Research, (CICR) Coimbatore in 2013 revealed that the following species of *Cleome sp, Commelina benghalensis, Corchorus sp, Euphorbia sp/hirta/geniculata,, Phyllanthus sp, Tridax procumbens, Phaseolus trilobus, Cynodon dactylon, and Panicum sp* were observed in control plot. Cotton field where dinitroaniline chemical based weed control followed infested with the species of *Trianthema portulacastrum, Amaranthus sp, Boerhaavia diffusa, Parthenium hysterophorus, Phyllanthus sp, Dactyloctenium aegyptium, Echinochloa sp, Panicum sp, and Cyprus rotundu* (Table 1). The absolute density of total weeds (506.0/m^2) registered in control plot was higher as compared to 260.7/m^2 recorded by dinitroaniline based weed control fields. Animesh Singh *et al.*, (2017) [2]. And Sasode *et al.*, (2017) [16]. Observed that weed management practices resulted in significant reduction in total weed density.

Table 1: Population dynamics of weed species occurred at cotton Pendimethalin in applied and non-applied field

Sl. No	Weed Species	AD		Occurrence		RD		AF		RF		IV		SDR	
		DNC	control	DNC	control	DNC	control	DNC	control	DNC	control	DNC	control	DNC	control
1	*Trianthema portulacastrum*	105.7	0	5.0	0	40.5	0.0	83.3	0.0	18.5	0.0	59.0	0.0	29.5	0.0
2	*Amaranthus sp*	11.7	0	2.5	0	4.5	0.0	41.7	0.0	9.2	0.0	13.7	0.0	6.9	0.0
3	*Boerhaavia diffusa*	2.0	0	1.0	0	0.8	0.0	16.7	0.0	3.1	0.0	3.9	0.0	1.9	0.0

4	*Cleome sp*	0.0	4.3	0.0	2	0.0	0.8	0.0	33.3	0.0	6.9	0.0	7.7	0.0	3.9
5	*Commelina benghalensis*	0.0	25.3	0.0	4	0.0	5.0	0.0	66.7	0.0	13.8	0.0	18.8	0.0	9.4
6	*Corchorus sp*	0.0	0.7	0.0	1	0.0	0.1	0.0	16.7	0.0	3.4	0.0	3.6	0.0	1.8
7	*Euphorbia sp/hirta/geniculata*	0.0	211.3	0.0	6	0.0	41.8	0.0	100.0	0.0	20.7	0.0	62.5	0.0	31.2
8	*Parthenium hysterophorus*	23.0	0	4.0	0	8.8	0.0	66.7	0.0	15.3	0.0	24.2	0.0	12.1	0.0
9	*Phyllanthus sp*	2.0	7.3	1.0	2	0.8	1.4	16.7	33.3	3.1	6.9	3.9	8.3	1.9	4.2
10	*Tridax procumbens*	0.0	14	0.0	3	0.0	2.8	0.0	50.0	0.0	10.3	0.0	13.1	0.0	6.6
11	*Phaseolus trilobus*	0.0	2	0.0	3	0.0	0.4	0.0	50.0	0.0	10.3	0.0	10.7	0.0	5.4
	Broad leaved weeds	144.4	264.9	13.5	21.0	55.4	52.4	225.1	350.0	49.2	72.4	104.7	124.8	52.3	62.4
12	*Cynodon dactylon*	0.0	5.3	0.0	1	0.0	1.0	0.0	16.7	0.0	3.4	0.0	4.5	0.0	2.2
13	*Dactyloctenium aegyptium*	1.3	0	1.0	0	0.5	0.0	16.7	0.0	3.8	0.0	4.3	0.0	2.2	0.0
14	*Echinochloa sp*	6.3	0	2.0	0	2.4	0.0	33.3	0.0	6.3	0.0	8.7	0.0	4.3	0.0
15	*Panicum sp*	16.0	234.7	4.5	6	6.1	46.4	75.0	100.0	17.6	20.7	23.8	67.1	11.9	33.5
	Grasses	23.6	240.0	7.5	7.0	9	47.4	125	116.7	27.7	24.1	36.8	71.6	18.4	35.8
16	*Cyprus rotundus*	92.7	1	6.0	1	35.5	0.2	100.0	16.7	23.0	3.4	58.6	3.6	29.3	1.8
	Total	260.7	505.9	27.0	29.0	100.0	100.0	450.0	483.3	100.0	100.0	200.0	200.0	100.0	100.0

The sizeable population of grassy weeds (240/m^2) registered in control plot was not observed with chemical applied fields (23.6/m^2).The weed analysis further revealed that broad leaved weeds are dominant in both the situation of chemical applied and control plot respectively with absolute density (AD) of 265.9 and 144.4 /m^2, relative density (RD) of 55.4 and 52.6%, relative frequency of 49.2 and 76.1%, important value of 104.7 and 128.5 and summed dominance ratio of 52.3 and 64.3. Although fluchloralin and pendimethalin are known to control of grasses and broad leaved weeds effectively, the result conclude that the chemicals are more effective on grasses than broad leaved weeds. The *Cyprus rotundus* registered with AD of 0.1 and 92.74, RD of 0.1 and 35.5%, RF of 0.1 and 23.0%, IV of 0.1 and 58.6 and SDR of 0.1 and 29.3 at control and chemical applied field respectively revealed that *Cyprus rotundus* is minor one become dominant by continuous use of dinitroaniline based weed control

Amongst different species, *Trianthema portulacastrum* (itsit) is the major one in chemical weeding followed plot recording a high value of relative density (RD, 40.5%), relative frequency (RF, 18.5 %), importance value (IV, 59.0) and summed dominance ratio (SDR, 29.5). It is closely followed by *Cyperus rotundus* (motha) in those above indices (with 35.5 % RD, 23.0 % RF, 58.6 IV and 29.3 SDR) (Table 1). On the contrary, Control field the dominant species here is *Panicum repens* with RD of 46.4 %, RF of 17.6 %, IV of 67.1 and SDR of 33.5. Fried *et al* (2015) [8]. Found that frequency of two-thirds of most common species has changed, once considered rare becoming very common (e.g. *Geranium dissectum*) and, common species becoming rarer (e.g. *Stellaria media*). Weed species success was favoured by tolerance to oilseed rape herbicides. Thus, over the years, weed species has shifted by following of dinitroaniline based weed control resulted in possible shifts from earlier grassy weeds and favored for invasion of broad leaved (*Trianthema portulacastrum*) and sedges (*Cyperus rotundus).*

Glyphosate based weed control

Control plot

Weed flora was more in number and diverse in Namakiripettai, Namakkal, (Dt) as compared to Rasipuram, Salem (Dt) (Table 2 and 3, Fig. 1, 2, 3,4)). The farm had adopted manual weeding only for weed control is kept as control plot for weed ecology survey. The control plot of Rasipuram infested with *Echinochloa colona, Panicum javanicum, Panicum repens, Amaranthus viridis, Boerhaavia diffusa, Borria hispida, Chorchorus sp, Cleome gynandra, Phyllanthus madraspetensis, Portulaca quadrifida, Commelina benghalensis* and *Cynotis culculata. Acalypha indica, Amaranthus viridis, Boerhaavia diffusa, Borreria hispida, Cleome gynandra, Commelina benghalensis, Corchorus aestuans, Cynodon dactylon, Cynotis culculata, Merremia emarginata, Parthenium hysterophorus, Phyllanthus amarus, Portulaca quadrifida, Trianthema portulacastrum, Tridox procumbens, Panicum repens, Dactyloctenium aegyptium, Digitaria longiflora, Echinochloa colona* and *Cyprus rotundus* were counted with Namakiripettai. The composition of species is varying between the surveyed regions. Cropping system and soil properties have greatest influence on the occurrence of weed species (Andreasen *et al.,* (1991) [1]. Streibig *et al*., (1984) [19]. And Punia *et al*., 2017) [13].

Table 2: Population dynamics of weed species occurred at cotton glyphosate applied and non-applied field at Rasipuram

Sl. No	Weed species	AD		RD%		Occurrence		AF%		RF (%)		IV		SDR	
		Glyphosate	Control	Glyphosate	Control	Glyphosate	Control	Glyphosate	Control	Glyphosate	Control	Glyphosate	Control	Glyphosate	Control
1	*Echinochloa colona*	0.24	369.8	1.96	86.1	1	18.0	0.06	100.0	5.26	22.8	7.22	108.9	3.61	54.4
2	*Panicum javanicum*	0	2.4	0	0.6	0	6.0		33.3		7.6		8.2		4.1
3	*Panicum repens*	0.71	23.1	5.88	5.4	2	7.0	0.12	38.9	10.53	8.9	16.41	14.2	8.2	7.1
	Grasses	0.95	395.3	7.84	92.0	3		0.18	172.2	15.79	39.2	23.63	131.3	11.81	65.6
4	*Amaranthus viridis*	0.71	8.9	5.88	2.1	3	5.0	0.18	27.8	15.79	6.3	21.67	8.4	10.84	4.2
5	*Boerhaavia diffusa*	0	13.6	0	3.2	0	13.0	0	72.2	0	16.5	0	19.6	0	9.8
6	*Borria hispida*	0	0.2	0	0.1	0	1.0	0	5.6	0	1.3	0	1.3	0	0.7
7	*Chorchorus sp*	0	0.2	0	0.1	0	1.0	0	5.6	0	1.3	0	1.3	0	0.7
8	*Cleome gynandra*	0	1.8	0	0.4	0	5.0	0	27.8	0	6.3	0	6.7	0	3.4
9	*Phyllanthus madraspetensis*	0	0.2	0	0.1	0	1.0	0	5.6	0	1.3	0	1.3	0	0.7
10	*Portulaca quadrifida*	0.24	2.2	1.96	0.5	1	6.0	0.06	33.3	5.26	7.6	7.22	8.1	3.61	4.1
11	*Commelina benghalensis*	2.59	6.4	21.57	1.5	6	14.0	0.35	77.8	31.58	17.7	53.15	19.2	26.57	9.6
12	*Trianthema*	0.24	0.0	1.96	0.0	1	0.0	0.06	0.0	5.26	0.0	7.22	0.0	3.61	0.0

	portulacastrum														
13	*Cynotis culculata*	0	0.7	0		0		0	5.6	0	1.3	0	1.4	0	0.7
	Broad leaved weeds	3.78	34.2	31.37		11		0.65	261.1	57.89	59.5	89.26	67.5	44.63	33.7
14	*Cyprus rotundus*	7.29	0.2	60.78		7		0.41	5.6	36.84	1.3	97.63	1.3	48.81	0.7
	Total	12.02	429.8	99.99		21		1.24	438.9	110.52	100.0	210.52	200.0	105.25	100.0

Table 3: Population dynamics of weed species occurred at cotton glyphosate applied and non-applied field at Namakiripettai

Sl. No		AD		Occurrence		RD		AF		RF		IV		SDR	
	Weed Species	Glyphosate	Control	Glyphosate	Control	Glyphosate	Control	Glyphosate	Control	Glyphosate	Control	Glyphosate	Control	Glyphosate	Control
1	*Acalypha indica*	0.0	2.0	0.0	3.0	0.0	0.7	0.0	37.5	0.0	3.3	0.0	4.1	0.0	2.0
2	*Amaranthus viridis*	0.5	6.0	3.0	4.0	2.6	2.2	37.5	50.0	5.8	4.4	8.4	6.6	4.2	3.3
3	*Boerhaavia diffusa*	1.0	9.5	4.0	7.0	5.2	3.4	50.0	87.5	7.7	7.8	12.9	11.2	6.5	5.6
4	*Borreria hispida*	0.3	6.0	1.0	5.0	1.3	2.2	12.5	62.5	1.9	5.6	3.2	7.7	1.6	3.9
5	*Cleome gynandra*	0.0	2.5	0.0	2.0	0.0	0.9	0.0	25.0	0.0	2.2	0.0	3.1	0.0	1.6
6	*Commelina benghalensis*	1.6	5.0	5.0	6.0	8.5	1.8	62.5	75.0	9.6	6.7	18.1	8.5	9.1	4.2
7	*Corchorus aestuans*	0.1	3.0	1.0	3.0	0.7	1.1	12.5	37.5	1.9	3.3	2.6	4.4	1.3	2.2
8	*Cynodon dactylon*	0.6	5.0	3.0	4.0	3.3	1.8	37.5	50.0	5.8	4.4	9.0	6.2	4.5	3.1
9	*Cynotis culculata*	6.0	9.0	8.0	6.0	31.4	3.2	100.0	75.0	15.4	6.7	46.8	9.9	23.4	4.9
10	*Merremia emarginata*	0.4	6.0	1.0	3.0	2.0	2.2	12.5	37.5	1.9	3.3	3.9	5.5	1.9	2.7
11	*Parthenium hysterophorus*	0.1	7.0	1.0	4.0	0.7	2.5	12.5	50.0	1.9	4.4	2.6	7.0	1.3	3.5
12	*Phyllanthus amarus*	0.8	7.0	3.0	3.0	3.9	2.5	37.5	37.5	5.8	3.3	9.7	5.8	4.8	2.9
13	*Portulaca quadrifida*	0.0	2.5	0.0	1.0	0.0	0.9	0.0	12.5	0.0	1.1	0.0	2.0	0.0	1.0
14	*Trianthema portulacastrum*	1.0	4.0	4.0	4.0	5.2	1.4	50.0	50.0	7.7	4.4	12.9	5.9	6.5	2.9
15	*Tridox procumbens*	0.0	3.0	0.0	3.0	0.0	1.1	0.0	37.5	0.0	3.3	0.0	4.4	0.0	2.2
	Broad leaved weeds	12.4	77.5	34.0	58.0	64.8	27.8	425.0	725.0	65.4	64.4	130.2	92.2	65.1	46.1
16	*Panicum repens*	0.9	61.0	4.0	8.0	4.6	21.9	50.0	100.0	7.7	8.9	12.3	30.8	6.1	15.4
17	*Dactyloctenium aegyptium*	0.3	62.5	2.0	8.0	1.3	22.4	25.0	100.0	3.8	8.9	5.2	31.3	2.6	15.6
18	*Digitaria longiflora*	0.3	2.5	1.0	2.0	1.3	0.9	12.5	25.0	1.9	2.2	3.2	3.1	1.6	1.6
19	*Echinochloa colona*	0.8	64.0	3.0	8.0	3.9	22.9	37.5	100.0	5.8	8.9	9.7	31.8	4.8	15.9
	Grasses	2.1	190.0	10.0	26.0	11.1	68.1	125.0	325.0	19.2	28.9	30.4	97.0	15.2	48.5
20	*Cyprus rotundus*	4.6	11.5	8.0	6.0	24.2	4.1	100.0	75.0	15.4	6.7	39.6	10.8	19.8	5.4
	Total	19.1	279.0	52.0	90.0	100.1	100.0	650.0	1125.0	100.0	100.0	200.1	200.0	100.1	100.0

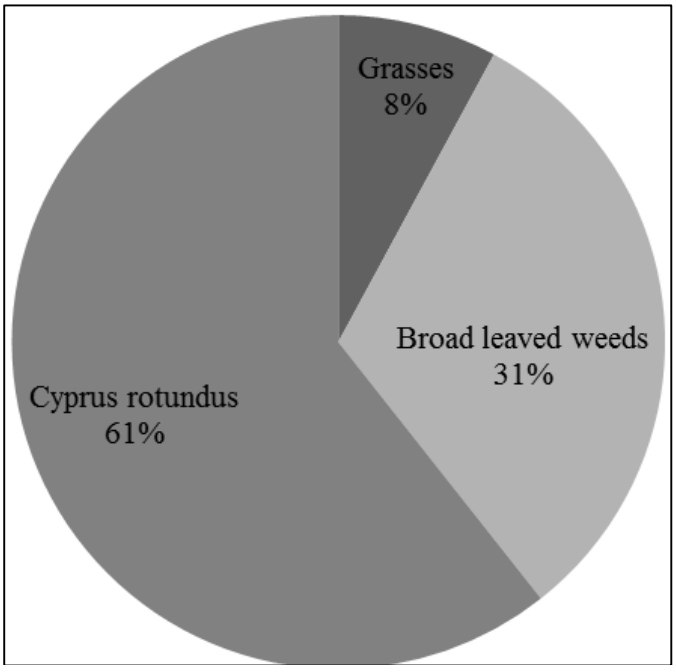

Fig 1: Relative Weed Density (%) of glyphosate applied field at Rasipuram

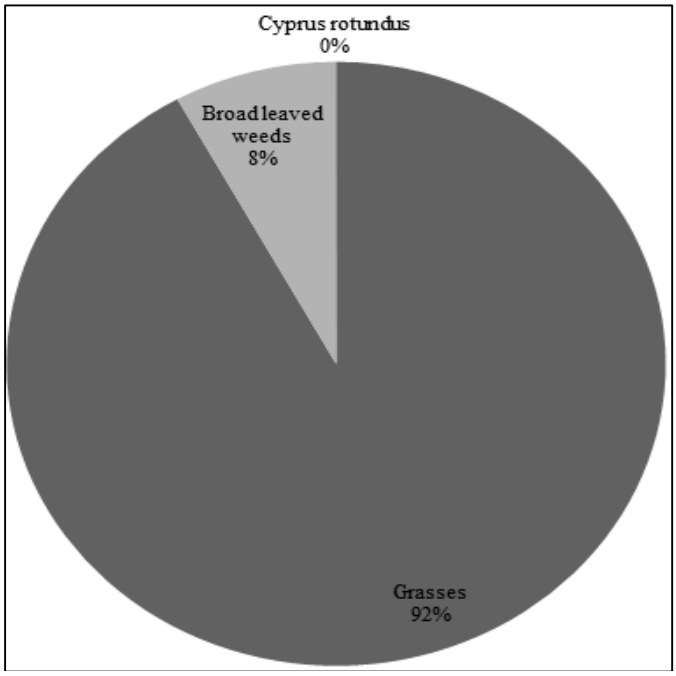

Fig 2: Relative Weed Density (%) of control field at Rasipuram

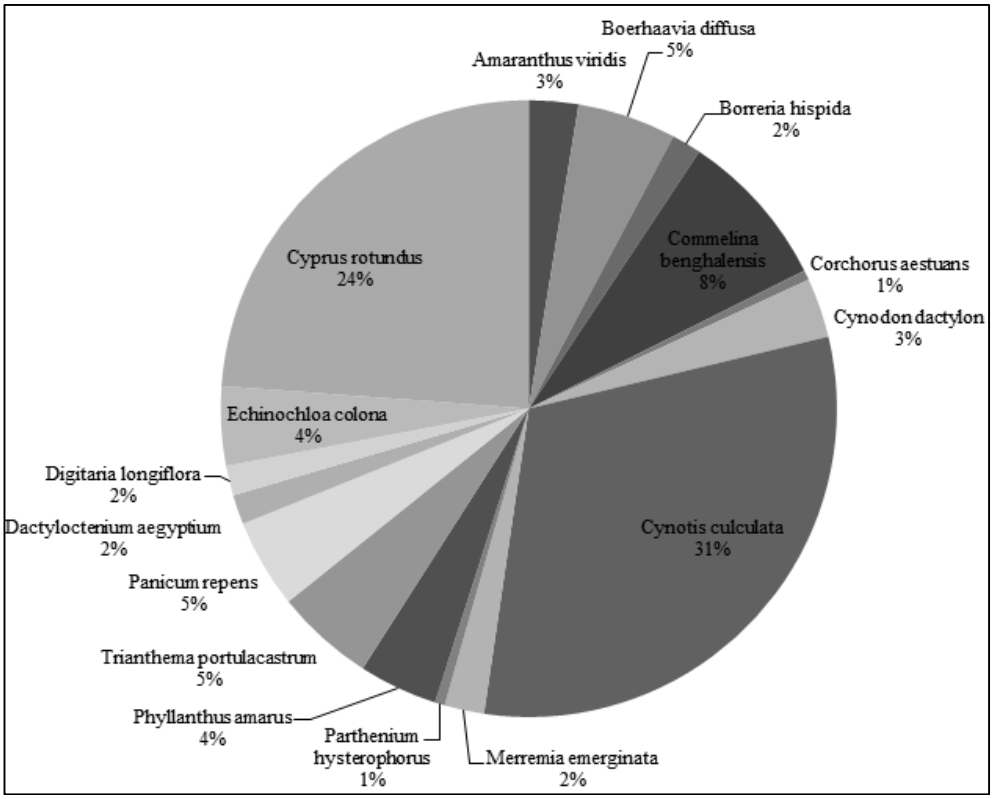

Fig 3: Relative Weed Density (%) of glyphosate applied field at Namagiripettai

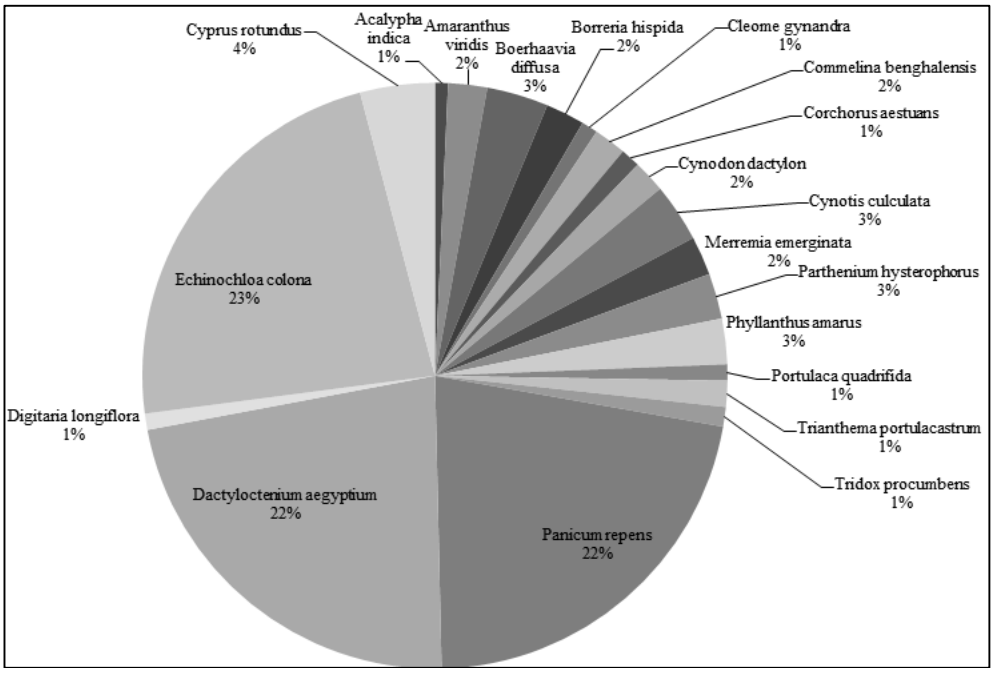

Fig 4: Relative Weed Density (%) of control field at Namagiripettai

The weed vegetation analysis found that absolute weed density of 429.8/m^2 were recorded in control plot, out of which 396.0 are grasses and 33.8 are broad leaved weeds with negligible level of sedges (*Cyprus rotundus*) at Rasipuram. At Namakripettai the absolute weed density of 279/m^2 were recorded in control plot, out of which 190 are grasses and 77.5 are broad leaved weeds with 11.5/ m^2 of sedges (*Cyprus rotundus*). The type of irrigation, cropping pattern, and weed control measures and environmental factors have a significant influence on variation an intensity and infestation of weeds (Saavedra *et al.* 1990) [15]. Of different regions. Hence the differences of weed density between two places is not uncommon one. Pinke *et al*., (2016) [12]. Revealed that environmental variables accounted for about four times more variance than cultural and about two and half times more than weed management variables. Borger *et al*., (2012) [4]. Reported that between 1997 and 2008, noticeable decreases in incidence (in cropped fields) were observed for *Vulpia* spp. (-25%), *Aira caryophyllea* (-21%), *Bromus diandrus* (-20%), *Avena fatua* (-18%) and *Austrostipa* spp. (-13%), with only *Raphanus raphanistrum* (11%) and *Arctotheca calendula* (7%) significantly increasing in frequency.

The relative density analysis found that amongst total weeds population, 92.2 per cent are grasses and 7.9 per cent are broad leaved weeds. *Echinocloa colona* is the predominant and observed with absolute density of 369.8 / m^2, relative

density of 86.1 per cent, important value index of 109.2 and summed dominance ratio of 54.6at Rasipuram. The similar trend with varied intensity of vegetation was obsrerved in Namagirpettai. *Echinocloa colona* is the predominant and observed with absolute density of 64.0 / m^2, relative density of 22.9 per cent, important value index of 31.82 and summed dominance ratio of 15.9at Namagirpettai. In Both the places grasses were dominant with specific pre dominance of *Echinocloa colona* in control plot.

Glyphosate used

The weed vegetation analysis of the fields, which are followed glyphosate based weeding for last 20 years noticed with weed spectrum of *Echinochloa colona, Panicum repens, Amaranthus viridis, Phyllanthus madraspetensis, Portulaca quadrifida, Commelina benghalensis, Trianthema portulacastrum* and *Cyprus rotundus at Rasipuram.* In Namagiripettai glyphosate applied field were counted with *Amaranthus viridis, Boerhaavia diffusa, Borreria hispida, Commelina benghalensis, Corchorus aestuans, Cynodon dactylon, Cynotis culculata, Merremia emarginata, Parthenium hysterophorus, Phyllanthus amarus, Trianthema portulacastrum, Panicum repens, Dactyloctenium aegyptium, Digitaria longiflora, Echinochloa colona, and Cyprus rotundus.* The results revealed that weed population is significantly reduced and reached the absolute density of 12.0 and 19.1 /m^2 as compared to control field (429.8 and 279 / m^2) respectively at Rasipuram and Namakiripettai. The large population of grassy weeds registered in control field at the rate of 395.3 and 190.0/m^2 were reduced to 0.95 and 2.1 /m^2 respectively at Rasipuram and Namagiripettai. Grasses are usually more susceptible to glyphosate than broad-leaved weeds (Baylis 2000) [3]. However, in glyphosate applied fields, broad leaved weeds were dominant in both the location. The broad leaved weeds counted with absolute density (AD) of 3.78 and 12.4 /m^2, relative density (RD) of 31.37 and 64.8%, relative frequency of 57.89 and 65.4%, important value of 89.3 and 130.2and summed dominance ratio of 44.63 and 46.1 at Rasipuram and Namagiripettai respectively. Where glyphosate has been used very intensively, there has been a marked rise in the dominance of broad-leaved weeds, eg *Asystasia spp, Heydyotis spp, Borreria* spp. (Baylis, 2000) [3]. The *Cyprus rotundus* registered as minor one with RD of 0.1 and 4.1%, RF of 0.1 and 6.7%, IV of 0.1 and 10.8 and SDR of 0.1 and 5.4.at Rasipuram and Namagiripettai respectively become dominant by continuous use of glyphosate and observed with RD of 60.8 and 24.2%, RF of 36.89 and 15.4%, IV of 97.63 and 39.6 and SDR of 48.8 and 19.8. Differences in the susceptibility of various species with glyphosate was reported by DeGennaro *et al.,* (1989) [6]. The relative density analysis of glyphosate used farm revealed that, *Cyprus rotundus* is predominant (60.78 per cent) followed by *Commelina benghalensis* (21.57 per cent) at Rasipuram. The Important value and Summed dominance ratio found that *Cyprus rotundus* recorded the highest of 94.12 and 47.06 respectively followed by *Commelina benghalensis* of 50.14 and 25.07 at Rasipuram. The similar situation of glyphosate used farm of Namagiripettai, the relative density analysis revealed that, *Cynotis culculata* is predominant (31.4 per cent)) followed by *Cyprus rotundus* (24.2 per cent).The Important value and Summed dominance ratio found that *Cynotis culculata* recorded the highest of 46.8 and 23.4 respectively followed by *Cyprus rotundus* of 39.6 and19.8 at Namagiripettai. The results further raveled that *Commelina benghalensis, Cyprus rotundus* and *Cynotis culculata* observed tolerance to glyphosate. Multiple mechanisms are involved in the greater tolerance of some species to glyphosate application as reported by Duncan *et al.,* (1987) [7].

Weed Shift – Glyphosate

Although fluchloralin and pendimethalin are known to control of grasses and broad leaved weeds effectively, the result conclude that the chemicals are more effective on grasses than broad leaved weeds. The shifts from earlier grassy weeds and favored for invasion of broad leaved (*Trianthema portulacastrum*) and sedges (*Cyperus rotundus), Echinocloa colona* is predominant species in control plot which reduced to minor one by continuous use of glyphosate. Weed species were shifted to *Cyprus rotundus and* Commelina *benghalensis* at Rasipuram. The shift of weed species to *Cynotis culculata* and *Cyprus rotundus* was observed from Namagiripettai. This varying tolerance to glyphosate between plants gives rise to l problem of weed shift as reported by Baylis, (2000) [3]. Keller *et al.* (2014) [9]. *Reported that* a weed population shift towards thermophilic species; *Alopecurus myosuroides* and *Echinochloa crusgalli* were the most frequent grass weeds; the former declining in frequency by 1.1% per year, the latter increasing by 1.5% by long-term Use of Herbicides in Maize in South-Western Germany. Mas *et al*., (2010) [10]. found that fields had a significantly higher relative abundance of perennials (52% versus 32%) and of dicotyledons (66% versus 39%) more than five years use of glyphosate

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