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Distribution of Weed Population in the Costal Rice Growing Area of Kedah in Peninsular Malaysia

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Abstract: This study aimed to develop appropriate weed management technology on selected salt tolerant rice variety(s) as well as to develop package of production technologies for rice in saline environments of Malaysia. This study was conducted at 40 different rice fields in 10 blocks of Kedah coastal area of West Malaysia during June-July, 2009 to identify most common and prevalent weeds associated with rice. Fields survey were done according to the quantitative survey method by using 0.5×0.5 m size quadrate with 20 samples from each field. A total of 42 different weed species belonging to 17 families were identified of which 25 annual and 17 perennial; 9 grassy weeds, 11 sedges and 22 broadleaved weeds. *Leptochloa chinensis*, *Echinochloa crusgalli*, *Fimbristylis miliacea*, *E. colona*, *Cyperus iria*, *Sphenoclea zeylanica*, *Cyperus deformis*, *Oryza sativa spontanea*, *Scirpus grossus* and *Jussia linifolia* were most frequent species covering more than 50% fields. Based on relative abundance indices, annuals were more dominant than perennials. *Leptochloa chinensis*, *Echinochloa crusgalli*, *Fimbristylis miliacea*, *E. colona* were most dominant weed species in the coastal rice field of Kedah.

Key words: Rice, weed, survey, relative abundance, salinity

INTRODUCTION

Rice is one of the most important sources of world's food supply and the third most important crop in Malaysia, which is mainly grown in eight granary areas in Peninsular Malaysia covering an area of about 209, 300 ha (Azmi and Mashhor, 1995). In Malaysia 2006, total rice production was 2154 thousand tons and growing area was 645 thousand hectors (USDA, 2008). Among these, the largest granary is in Kedah which covers 98, 860 ha with an average yield of 4.12 ton ha^{-1} (Abd-kadir and Kamariah, 2003). Salinity is one of the dramatic factors for reducing yield of rice. In arid and semi arid regions limited water and hot dry climates frequently cause salinity that limit or prevent crop production. At low concentrations salt suppresses plant growth and higher concentration can cause death (Waldron *et al*., 2004). Due to anthropogenic contributions to global warming, the rate of sea-level rise is expected to increase and dramatic affect on rice production. Rising sea-levels may result in changes to the fresh-water lens which could adversely affect of tropical agriculture. Sea water expands due to the melting of ice at the polar and temperate regions of the world by increasing the average temperature of earth. Besides these, frequency of flood will be increased and many new areas will be inundated by saline water. Information on the role of photosynthesis in salt tolerance of barnyard grass (*E. crusgalli*) is lacking. Domestication of barnyard grass for reclamation of saline soil could be promising if its salt tolerance is improved (Abogadallah and Quick, 2009). Weed is a serious pest of rice and causes annual worldwide rice yield loss by weed is 15-21% (De Datta, 1990; Oerke *et al*., 1994). A crop loss due to weed competition varies with the duration of weed infestation of the crop. The crop is likely to experience yield reduction, unless weeds are kept free during a part of its growing period (Azmi *et al*., 2007) and totally uncontrolled conditions can reduce grain yields of rice by 42-100% (Begum, 2006). On the other hand, Kim *et al.* (1999) reported that weeds are relatively tolerant to salinity in comparison with rice. Since, human activities through agronomic management such as plant establishment technique, irrigation and fertilizer used and type, rate and effectiveness of herbicides affect the changes of weed flora. The ecological shift of weed species from broad-leaved weeds and sedges in

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transplanted rice culture to competitive grassy weeds in direct seeded rice, was found to be related to the continuous use of herbicides in weed control operation (Azmi and Baki, 1995; Ho, 1998). Therefore, weed survey is useful for determining the occurrence and importance of weed species in any production systems and area (Kevin *et al.*, 1991; Frick and Thomas, 1992; McCloskey *et al*., 1998).

This study can help elucidate the effect of new weed control technologies on farming practices, document weed species shifts in response to new weed control technologies and document the development of herbicide resistant weeds in the coastal rice field area. Documenting the relative importance of weed species also facilitates the establishment of priorities for research and extension activities (McClosky *et al*., 1998). Therefore, monitoring these temporal changes in weed species composition is important to reformulate appropriate weed management strategies in the rice field. However, detailed information on the presence, composition, abundance, importance and ranking of weed species especially in coastal rice field area of Malaysia are rare. Knowledge on the nature and extent of infestation of weed flora in rice field area through weed surveys is essential in formulating relevant rice weed control strategies in order to enhance the quality of coastal rice field area of Kedah. For proper weed management in the rice field, it is essential to know the major weeds in the coastal area of Kedah. A detail study is needed to identify the current status of troublesome weeds including occurrence, composition and distribution of weed communities prevailing in rice field area in Kedah of Peninsular Malaysia. Therefore, the present study was undertaken to investigate the distribution and severity of weed flora prevailing in different blocks in Kedah rice growing area.

MATERIALS AND METHODS

A survey was conducted in coastal rice field areas in Kedah of Peninsular Malaysia to identify the major weeds during the period of June-July, 2009. There are 27 blocks in Kedah rice field area. Among these 10 blocks are in coastal area (Fig. 1). A total of forty rice fields planted with MR219 variety were surveyed throughout the 10 blocks. During the survey the age of rice plant was 60 days and field was ponded with 2-4 cm water. Surveyed area was situated on 06°21 N latitude and 100°09 E longitude. The average temperature during June- July was 24-30°C, humidity was 80%. Field surveyed was done according to the quantitative survey method described by Thomas (1985). An inverted W pattern was used to systematically walk each sample field. Forty rice fields were sampled along each arm W pattern, giving total number of 20 quadrates (Fig. 2) per field. On a uniform field, the first encountered corner of the field was the starting point. 0.5×0.5 m size quadrate was used. The distance among quadrates were fixed upon the size and shape of the field and any obstructions that may had been present in the field. All weeds in each quadrate were identified, counted and recorded. Species that was not identified in the field was tagged and transported for later identification (Chancellor and Froud-Williams, 1982, 1984). Probable anomalies were carefully avoided such as, shoulder and foot slopes, potholes, ditches, bluffs, power lines and paths were not sampled.

The data were summarized using five quantitative measures as frequency, field uniformity over all fields, density over all fields, density occurrence fields and relative abundance (Thomas, 1985). Frequency (F) was calculated as the percentage of the total number of fields surveyed in which a species occurred in at least one quadrate.

$$F_k = \frac{\sum_{1}^{n} Y_i}{n} \times 100$$

Where:
F_k = Frequency value for species k
Y_i = Presence (1) or absence (0) of species k in field i
n = No. of fields surveyed

Field Uniformity (FU) was calculated as the percentage of the total number of quadrates sampled in which a species occurred.

$$FU_k = \frac{\sum_{1}^{n}\sum_{1}^{20} X_{ij}}{20n} \times 100$$

Where:
FU_k = Field uniformity value for species k
X_{ij} = Presence (1) or absence (0) of species k in quadrate j in field i
n = No. of fields surveyed

The field density (D) of each species in a field was calculated by summing the number of plants in all quadrates and dividing by the area of 20 quadrates.

$$D_{ki} = \frac{\sum_{1}^{20} Z_i}{A_i}$$

Where:

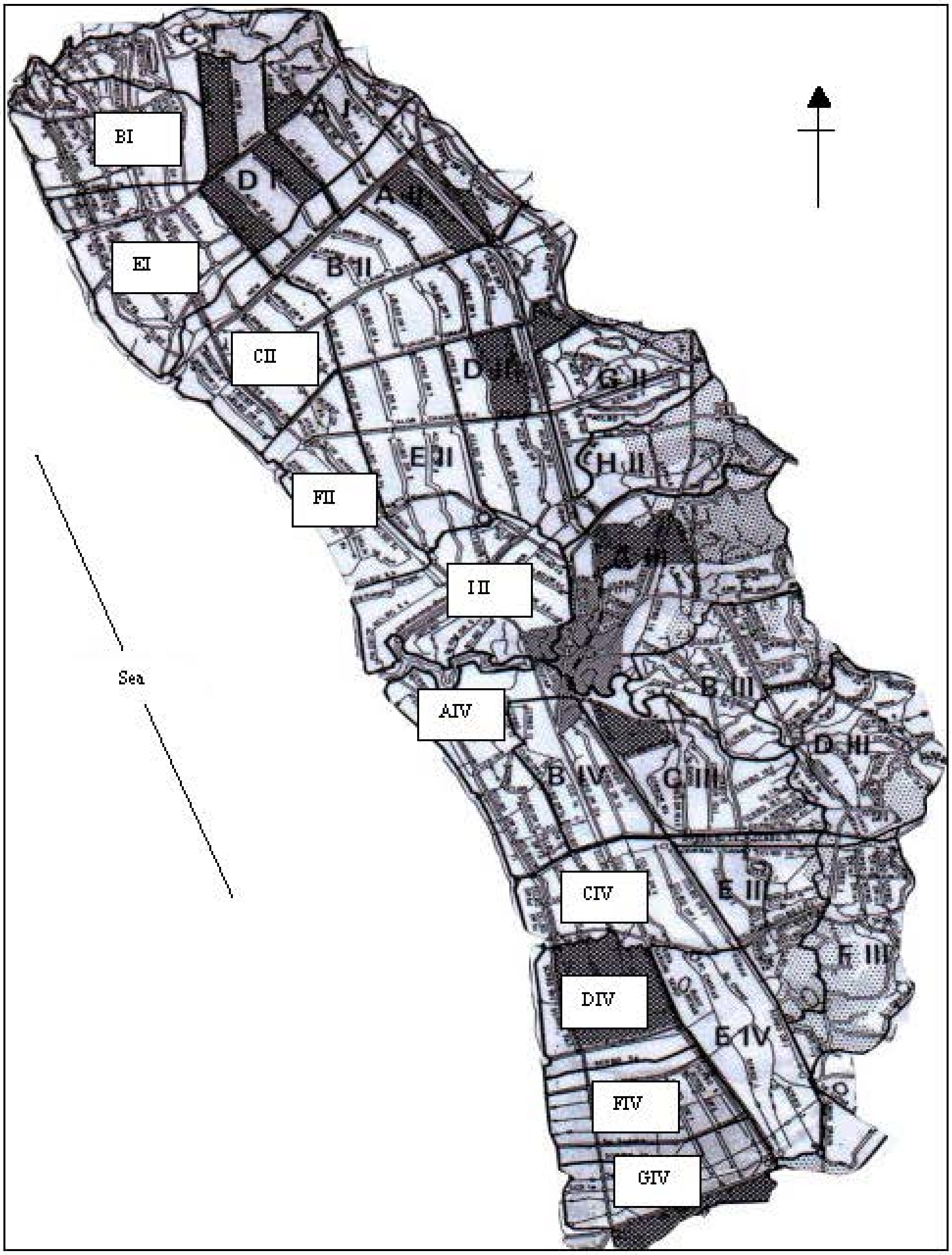

Fig. 1: Map of Kedah rice growing area indicating the coastal region (BI, EI, CII and FII, I II, AIV, CIV, DIV, FIV and G1V)

D_{ki} = Density (in numbers m^{-2}) value of species k in field i

Z_j = No. of plants of a species in quadrate j (a quadrate is 0.25^2 m)

A_i = Area in m^2 of 20 quadrates in field i

Mean Field Density (MFD) is the mean number of plants m^{-2} for each species averaged over all fields sampled.

$$MFD_k = \frac{\sum^{n} D_{ki}}{n}$$

Where:

MFD_k = Mean field density of species k

D_{ki} = Density (in numbers m^{-2}) of species k in field i

n = No. of fields surveyed

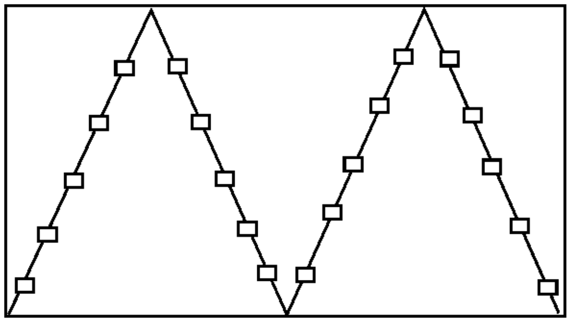

Fig. 2: The counted number and weeds species shows inverted W with four transects each with 5 quadrates out of total 20 quadrates. The length of every transect and distance between quadrates was adjusted for well coverage of field as it was not square

Mean Occurrence Field Density (MOFD) was the mean number of plants m^{-2} for a weed species averaged over only the fields in which that species occurred.

$$MOFD_k = \frac{\sum_{1}^{n} D_{ki}}{n-a}$$

Where:

$MOFD_k$ = Mean occurrence density of species k

D_{ki} = Density (in numbers m^{-2}) of species k in field i

n = No. of fields surveyed

a = No. of fields from which species k is absent

Relative Abundance (RA) was used to rank the weed species in the survey and it was assumed that the frequency, field uniformity and mean field density measures were of equal importance in describing the relative importance of a weed species. This value has no units but the value for one species in comparison to another indicates the relative abundance of the species (Thomas and Wise, 1987). The Relative Frequency (RF), Relative Field Uniformity (RFU) and Relative Mean Field Density (RMFD) was calculated by dividing the parameter by the sum of the values for that parameter for all species and multiplying by 100.

Relative frequency for species k (Rf_k):

$$RF_k = \frac{\text{Frequency value of species}}{\text{Sum of frequency values for all species}} \times 100$$

Relative field uniformity for species k (RFU_k):

$$RFU_k = \frac{\text{Field uniformity value of species k}}{\text{Sum of field uniformity values for all species}} \times 100$$

Relative mean field density for species k ($RMFD_k$):

$$RMFD_k = \frac{\text{Mean field density value of species k x}}{\text{Sum of mean field density values for all species}} \times 100$$

The relative abundance of species k (RA_k) was calculated as the sum of relative frequency, relative field uniformity and relative mean field density for that species:

$$RA_k = RF_k + RFU_k + RMFD_k$$

Relative abundance value is an index that was calculated using a combination of frequency, field uniformity and field density for each species, as described by Thomas (1985). The sum of the combined relative abundance values for all species in a community is 300. Relative abundance allows for comparison of the overall abundance of one weed species vs. another.

RESULTS AND DISCUSSION

A total of 42 different weed species including 25 were annuals and 17 perennials, comprising 9 grasses, 11 sedges and 22 broadleaved weeds were identified in different rice field of coastal area at kedah (Table 1). The annual species was greater in number than perennial species and overall annual grasses were more prevalent than perennial grasses due to lack of satisfactory control measure either cultural or herbicide application. Similarly, ninety-one weed species were identified in wheat fields treated with a herbicide post harvest. Similarly, Al-Gohary (2008) found that perennial weeds especially grasses were higher than annual weeds in eleven wadis of Gebel Elba districts in Egypt. The weed species represented 17 families. Among which Cyperecae family had the highest number of weed species (11), followed by Poaceae (9), Pontederiaceae (3), Euphorbiaceae (3), Convolvulaceae (2), Rubiaceae (2), Asteraceae (2). Rests of the 10 families were represented by one species each (Table 1). Poaceae and Cyperaceae accounted together 45% of the species. However, seventy-one weed species of rice plantations belonging to 28 families were recorded in the Delta costal region. The most represented families were Gramineae (28.2%), Compositae (8.5%), Cyperaceae (7%), Malvaceae, Lythraceae, Chenopodiaceae and Leguminosae (5.6%) and Convolvulaceae (4.2%) (Turki and Sheded, 2002). Generally, the weed vegetation of a particular area is determined not only by the environment but also edaphic and biological factors that include soil structure, pH, nutrients and moisture status, associated crops, weed control measures and field history especially in local geographical variation (Kim *et al*., 1983).

Table 1: Distribution of weed species based on family, scientific name, common name and life cycle

Family name	Scientific name	Common name	Life cycle
Grasses			
Poaceae	*Cynodon dactylon* (L.) Pers.	Bermuda grass	P
	Echonochloa colona (L.) Link	Jungle rice, Birds rice	A
	Echonochloa crussgalli (L.) Beauv	Barnyard grass	A
	Eleusin indica (L.) Gaertn.	Goose grass	A
	Paspalam conjugatum Berg.	Buffalo grass	P
	Paspalam vegenatum	Water couch grass	P
	Ischaemum regosum Salisb.	Wrinkled grass	P
	Leptochloa chineusis (L.) Nees	Feather grass	A
	Oryza sativa L. (Weedy rice)	Oryza rufipogon/weedy rice	A
Sedges			
Cyperaceae	*Cyperus difformis* L.	Small-flowered umbrella plant	A
	Cyperus babakeusis Steud	Babakensis clarke	P
	Cyperus distans L.f.	Slender cyperus	P
	Cyperus iria L.	Grasshopper's cyperus	A
	Cyperus rotandus L.	Nut grass	P
	Cyperus pilosus Vahl	Fuzzy flat sedge	A
	Fimbristylis globulosa (Rezt.) Kunth	Globular fimbristylis	P
	Fimbrystylis melliacea (L.) Vahl	Lesser fimbristylis	A
	Scirpus grossus L.f.	Creater club-rush	P
	Scirpus supinus	Rush hair sedge	A
	Scirpus mucronatus L.	Bogbulrush	P
Broad leaved			
Rubiaceae	*Borreria laevicanlis* Ridl	Purple-leaved Button Weed	P
	Hedyotis corymbosa (L) Lamk.	Two flowered oldenlandia	A
Scrophulariaceae	*Bacopa rotundifolia* (Michx.) Wettst.		A
Capparidaceae	*Cleome rutidosperma* DC.	Yellow cleome	A
Asteraceae	*Eclipta alba*	Eclipta	A
	Eclipta prostate (L.) L.	White heads	A
Boraginaceae	*Heliotropium indicum* L.	Buntut tikus	A
Convolvulaceae	*Ipomea triloba* L.	Little bell	P
	Ipomea aquatica L.		P
Onagraceae	*Jussiaea linifolia*	Narrow leaved willow herb	A
Butomaceae	*Limnocharis flava* (L.) Buchenau	Yellow sawah lettuce	P
Pontederiaceae	*Monochoria hastate* (L.) Solms	Pingo	A
	Monochoria vaginalis (Burm.f.) Presl	Oval-Leaved pond weed	A
	Echornia crassipes (Mart.) Solms	Water Hyacinth	P
Lytraceae	*Rotala indica* (Willd) Kochne	Ameletia aquatidens	A
Euphorbiaceae	*Euphorbia hirta* L.	Hairy spurge	A
	Phyllanthus urinaria L.	Chamber bitter	A
	Phyllanthus amarus Schum. and *Thonn.*	Lagoon spurge	A
Alismataceae	*Sagitaria guyaneusis* H.B.K. Bogin	Kelipok padang	P
Sphenocleaceae	*Sphenoclea zeylanica* Gaertn.	Gunda padi	A
Silviniaceae	*Salvania molesta* D.S. Mitchel	Kiambang	A
Marsileaceae	*Marsila crenata* Presl.	Semanggai	P

P: Pereunial, A: Annual

In terms of frequencies among the grasses the most common and frequent grass weed species was *Leptochola chinensis* that available in 31 rice fields (Table 2). The next occurred in frequencies ≥30% were *Echinochola crusgalli*, *E. colona*, *Oryza sativa* L. (Weedy rice), *Paspalam conjugatum* and *Ischamum rogosum*. Among the sedges the most widespread weed species in terms of frequencies was *Fimbristylis milicaea* followed by the other weeds that occurred ten or more than ten fields were *Cyperus iria*, *C. deformis*, *Scirpus grossus*. Among the broadleaved weeds the most frequent weed species was *Sphenoclea zeylanica* along with the other weeds that frequencies ≥30% were *Euphorbia hirta*, *Jussia linifolia*, *Ipomea aquatica*, *Limnocharis flava*, *Monocharia hastata*, *Monocharia vagenalis*, *Sagiteria guanenmsis* and *Marsila crenata*. Frequencies of the remaining grasses, sedges and broadleaved were 12 to 15%, 10 to 22% and 12 to 27%, respectively (Table 2). Uniformity is a quantitive measure of the spread of a weed species within a given field. For example grasses *L.chinensis*, *E. crusgalli*, *E. colona* sedges: *F. miliacea*, *C. iria*, *C. deformis*, *Scirpus grosus* and *Sphenoclea zeylanica*, *Jussia linifolia* were uniformly (≥50%) distributed throughout the fields (Table 2).

Leptochloa chinensis was the most abundant weed with a density of 5.67 plants m^{-2}. *Fimbristylis miliacea* was second most abundant weed with a density 5.06 plants m^{-2}. *Echinochloa crusgalli*, *E. colona*, *C. iria*,

Table 2: Frequency (F), Field Uniformity (FU), Mean Field Density (MFD) and Mean Occurrence Field Density (MOFD) of weeds in costal rice growing area of Kedah

Scientific name	F (%)	FU (%)	MFD (m^{-2})	MOFD (m^{-2})
Grasses				
Leptochloa chinensis	77.50	61.25	5.67	7.32
Echonochloa crussgalli	72.50	56.38	4.53	6.24
Echonochloa colona	62.50	38.75	3.46	5.53
Oryza sativa L. (Weedy rice)	50.00	26.88	2.85	5.69
Paspalam conjugate	37.50	7.63	0.59	1.57
Ischaemum regosum	32.50	13.50	1.34	4.12
Eleusin indica	15.00	1.75	0.10	0.67
Paspalam vegenatum	15.00	2.88	0.23	1.53
Cynodon dactylon	12.50	4.38	0.37	2.96
Sedges				
Fimbrystylis melliacea	67.50	48.00	5.06	7.50
Cyperus irria	60.00	34.75	3.18	5.30
Cyperus difformis	60.00	31.88	3.09	5.15
Scirpus grossns	52.50	24.75	2.54	4.83
Cyperus pilosus	27.50	4.13	0.48	1.75
Cyperus babakensis	22.50	8.63	1.01	4.47
Scirpus supinus	20.00	4.38	0.45	2.25
Cyperus distans	15.00	5.38	0.45	2.97
Scirpus mncronatus	15.00	4.00	0.36	2.37
Fimbristylis globulosa	12.50	6.00	0.43	3.44
Cyperus rotandus	10.00	4.75	0.34	3.36
Broadleaved				
Sphenoclea zeylanica	60.00	30.00	3.60	5.99
Jnssiaea linifolia	52.50	23.38	2.31	4.40
Monochoria vaginalis	37.50	8.25	0.74	1.97
Salvania molesta	37.50	10.63	0.88	2.33
Euphorbia hirta	35.00	4.25	0.32	0.91
Sagitaria guyanensis	35.00	14.25	1.24	3.54
Limnocharis flava	32.50	4.25	0.52	1.58
Ipomea aquatica	30.00	3.13	0.44	1.47
Eclipta alba	20.00	2.25	0.35	1.73
Marsila crenata	27.50	9.75	1.16	4.20
Rotala indica	25.00	3.38	0.27	1.06
Monochoria hastata	25.00	3.00	0.47	1.86
Heliotropium indicum	22.50	3.63	0.43	1.89
Bacopa rotundifolia	20.00	4.75	0.35	1.75
Echornia crassipes	20.00	3.63	0.48	2.40
Ipomea triloba	20.00	2.13	0.36	1.80
Phylenthus amaratus	20.00	1.75	0.25	1.25
Borreria laevicaulis	17.50	2.75	0.28	1.57
Cleome rutidosperma	17.50	2.25	0.27	1.54
Hedyotis corymbosa	17.50	4.88	0.48	2.75
Eclipta prostata	15.00	2.63	0.35	2.30
Phylanthus urinaria	12.50	1.38	0.12	0.92

C. deformis and *Sphenoclea zeylanica* was the other weed species with densities over 3 plants m^{-2} (Table 2). When examining the weed density of fields in which the species occurred, the density of most species increased compared to densities obtained from all fields. However, among the frequent weeds (≥20%) the density of some of the grasses, sedges and broadleaved such as *Paspalam vaginatum*, *C. distans*, *C. rotundus*, *F. globulosa*, *Eclipta prostata*, *Cleome rutidosperma*, *Hedyotis corymbosa* in occurrence fields (MOFD) were much higher than Mean Field Density (MFD), suggesting that site specific and/or management-specific factors were contributing to survival of those species. The low frequency and field uniformity contribute to the differences between MOFD and MFD. The weeds with the highest frequencies also had the highest field uniformities and mean field densities, indicating that these weeds were the most difficult to control. These species should be carefully monitored. On the other hand, all types of weeds that have field frequencies less than 40%, field uniformities less than 10 and mean field densities less than 2 plants m^{-2} may either less competitive with rice or may be effectively controlled by current weed management practice in study area.

Table 3: Relative abundance of grasses, sedges and broadleaf weeds that occurred in ten or more fields in Kedah rice growing area of West Peninsular Malaysia

Scientific name	Relative abundance (%)	Type of weed
Leptochloa chinensis	28.10	Grass
Echonochloa crussgalli	24.62	Grass
Fimbrystylis mellicea	23.71	Sedge
Echonochloa colona	18.53	Grass
Cyperus iria	17.07	Sedge
Sphenoclea zeylanica	16.98	Broad leaf
Cyperus difformis	16.36	Sedge
Oryza sativa L. (Weedy rice)	14.21	Grass
Scirpus grossns	13.41	Sedge
Jnssiaea linifolia	12.72	Broad leaf
Sagitaria guyanensis	7.65	Broad leaf
Ischaemum regosum	7.52	Grass
Salvania molesta	6.46	Broad leaf
Marsila crenata	6.09	Broad leaf
Monochoria vaginalis	5.76	Broad leaf
Paspalam conjugatum	5.36	Grass
Cyperus babakensis	5.22	Sedge
Limnocharis flava	4.21	Broad leaf
Euphorbia hirta	4.02	Broad leaf
Cyperus pilosus	3.75	Sedge
Ipomea aquatica	3.67	Broad leaf

For brevity, only the species that appeared in ten or more fields were ranked according to Relative Abundance (RA) value (Table 3). Among these weeds species belongs to 6 grasses, 6 from sedges and 9 were from broadleaved category. The most frequency 21 species accounted for 82% of the total relative abundance. Relative abundance provides an indication of the overall weed problem posed by a species. In descending order the top most 10 species that had the higher RA values were *Leptochloa chinensis*, *Echinochloa crusgalli*, *Fimbristylis miliacea*, *E. colona*, *Cyperus iria*, *Sphenoclea zeylanica*, *Cyperus deformis*, *Oryza sativa* L. (Weedy rice), *Scirpus grossus* and *Jussia linifolia*. The respective RA values for these weed species were 28.10, 24.62, 23.71, 18.53, 17.07, 16.98, 16.36, 14.21, 13.41 and 12.72, respectively (Table 3). In this study, most of the abundant weeds were annual in nature. It might be due to their compatible environment of cultivated annual rice plant. Kamal-Uddin *et al.* (2009) found that two sedges *C. aromaticus* and *F. dichotoma*, two grasses *E. indica* and *C. aciculatus*, two broad leaved *D. triflorum*, *B. repens* were equally important abundant species containing frequency ≥50% and RA value ≥12.

The ranking of weed species differed in the lists based on Frequency (F), Field Uniformity (FU) and Mean Field Density (MFD) but, within the weed type, except *L. chinensis* the higher RA value reflects its respective higher values of Frequency (F), Field Uniformity (FU) and mean field density (Table 2, 3). Even though, *L. chinensis* followed by *E. crussgalli* and *F. miliacea* and consistently were top two abundant species irrespective of frequency (F) and *F. miliacea* was higher in Field Uniformity (FU) and Mean Field Density (MFD) or Mean Occurrence Field Density (MOFD). This result indicates that *L. chinensis*, *E. crussgalli* and *F. miliacea* is clearly the most serious weed in rice growing areas. The two other grasses *E. colona*, *Oryza sativa* L. (Weedy rice) three *sedges C. iria*, *C. deformis*, *Scirpus grossus* and two broadleaved *Sphenoclea zeylanica*, *Jussia linifolia* were equally important abundant species containing frequency ≥50% and RA value ≥12. Thomas (1985) observed from weed survey that the relative abundance value clearly indicated a very few dominated weed species. Similarly, Xing *et al.* (2000) also observed that two species such as *C. rotundus* and *Digitaria sanguinalis* were more dominant out of 10 most dominant species. An almost similar pattern of weed dominance ranking was also observed in Muda area in the descending order of importance were the *E. crusgalli* complex, *L. chinensis*, *O. sativa* (weedy rice), *Ludwigia hyssopifolia*, *F. miliacea*, *Sphenolea zeylanica* and *Scirpus grossus* (Azmi and Baki, 2002). *Oryza sativa* complex ranked top followed by *Echinochloa crusgalli* and *Leptochloa chinensis*, *Ludwigia hyssopifolia* and *Fimbristylis miliacea* in block-1 of MUDA rice granary in Peninsular Malaysia (Begum *et al.*, 2008). Kim *et al.* (1999) explained that *Echinochloa oryzochola* are relatively tolerant to salt. *E. turnerana* has highly tolerance to salinity of 1% total salt. it is reported that seed germination and seed yield of population of *E. crusgalli* was depressed by treatments with saline solution. In another experiment we found that *Cyperus iria*, *Echinochloa colona* and *Jussia linifolia* showed salt tolerant up to 20 dS m^{-1} at seed germination and early seedling growth (unpublished data).

CONCLUSION

This survey provides the first quantitative comparison of the common species. Among the 10 abundant weed species four grasses viz., *Leptochloa chinensis*, *Echinochloa crusgalli*, *E. colona*, *Oryza sativa* L. (Weedy rice), four sedges viz., *Fimbristylis miliacea*, *Cyperus iria*, *Cyperus deformis*, *Scirpus grossus* and two broadleaved viz., *Sphenoclea zeylanica*, *Jussia linifolia* were found in the coastal rice growing area of Kedah, Malaysia. Overall, more survey work is needed on a regular basis to identify possible problematic weed and weed population shifts and direct research toward new or improved control measures.

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