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# Floristic Composition of Weed Community in Turf Grass Area of West Peninsular Malaysia

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## ABSTRACT

A survey was conducted at 50 different types turfgrass field such as football field, rugby field, hockey field, turf nursery, lawn area, landscape area, recreational park area, green golf and fairway golf in Malaysia during November-December 2007 to identify most common and prevalent weeds associated with turf grass. The turf grass areas were covered by four turf viz. *Axonopus compressus* (carpet grass), *Cynodon dactylon* (tifdwarf), *Zoysia matrella* (Manilla grass) and *Paspalum vaginatum* (seashore paspalum). Fields surveyed were done according to the quantitative survey method by using 0.5 m x 0.5 m size quadrat with 20 samples from each field. The data were summarized using five quantitative measures viz frequency, field uniformity mean fields density, mean occurrence field density and relative abundance. A total of 79 different weed species belongs to 16 families were identified of which 43 annual and 36 perennial; 30 grassy weeds, 17 sedges and 32 broadleaf weeds. *Cyperus aromaticus, Fimbristylis dichotoma*, *Chrysopogon aciculatus* and *Borreria repens* were most frequent species covering more than 50% fields. Based on relative abundance indices, perennials were more dominant than annuals. *C. aromaticus, F. dichotoma, Desmodium triflorum, Ischaemum indicum, C. aciculatus* and *B. repens* were more prevalent and abundant species out of 10 most weed dominant species in turf grass areas.

**Key Words**: Turf grass; Weed; Survey; Relative abundance

## INTRODUCTION

Turf grasses are plants that widely used as a ground cover. Turfs are important in human activities from functional, recreational and ornamental standpoint (Beard, 1998). Turf grasses especially sport turf play an important role by providing cushioning effect that could help reduce injuries to the participants and are mostly use in golf courses, sports fields (football, rugby, lawn, bowling, athletic) ornamental landscape (lawn), erosion control and other general purposes (Juraimi, 2001). These have attractive green colour, texture, density and uniformity (Emmons, 2000). In turf, weeds are a major problem and their presents are often the result of improper site preparation or inappropriate management. The weed can reduce the growth of turf, be a host to the other pests and make the surrounding not suitable to the turf growth. It also compete with turf for water, light, space and nutrient and become established more readily in thin and weak turf areas, instead of a vigorous and healthy turf (Gaussoin & Martin, 1994; Ahmad *et al*., 2003; Roberta *et al*., 2005). The presence of weeds in a turf grass community disrupts the uniformity and playability due to the variability in leaf width, color and growth habit. Therefore weeds must be eliminated from turf grass area to enrich aesthetic quality of turf. But, in any place a plant community is rarely homogenous throughout as to species and distribution (Kim & Moody, 1980). Furthermore weed distribution is the result of the compound influence of ecological and human factor. The diverse topographical and hydrological situation influences the macroclimate of the turf grass and alters both intensity and diversity of weeds. Even though 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. Weeds species that are a problem in turf grass areas can be divided into three primary biological categories, which are grasses, sedges and broadleaved (Bennet, 2004). It can spread rapidly in a turf area by means of seeds, rhizomes, stolons and various underground storage organs such as bulbs and tubers (Johns, 2004). Therefore weed surveys are useful for determining the occurrence and importance of weed species in any production systems as well as turf area (Thomas, 1985; McCully *et al*., 1991; Frick & Thomas, 1992; McClosky *et al.,* 1998). Turf grasses are the most important and emerging industry in Malaysia. As

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weeds appear in a turf grass community, proper identification of the weed species is essential before the most economical and effective management practices (Dernoeden, 1999).

Documenting the weed species present in turf grass fields and the herbicides and cultural practices used to control those weeds allows comparisons with past and future surveys. These comparisons 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. 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 to produce the good quality of turf grass. However detailed information on the presence, composition, abundance, importance and ranking of weed species in turf area are extremely rare. Knowledge on the nature and extent of infestation of weed flora in turf area through weed surveys is essential in formulating relevant turf weed control strategies in order to enhance the quality of turf grass, cosmetic appearance or short and long term performance. Little is known of the weed infestation in turf grass areas in Malaysia. Thus, the objects of this study were to identify the current status of troublesome weeds including occurrence, composition and distribution of weed communities prevailing in turf grass area in Malaysia.

## MATERIALS AND METHODS

A survey was conducted in turf grass areas in west Peninsular Malaysia to identify the major weeds. In different location, a total of 50 different types turf grass field such as 17 playing field (football field, rugby field, hockey field), 3 turf nursery, 9 landscape area, 5 lawn area, 5 recreational park area, 6 green golf and 5 fairway golf were surveyed. Surveyed area was situated on 03°6′ N latitude and 101°39′ E longitude. The average temperature from November to December was 24-30°C and humidity was 80%. The turf grass areas were covered by four turf viz. *Axonopus compressus* (carpet grass), *Cynodon dactylon* (tifdwarf), *Zoysia matrella* (Manilla grass) and *Paspalum vaginatum* (seashore paspalum). Fields surveyed were done according to the quantitative survey method described by Thomas (1985). An inverted "W" pattern was used to systematically walk each sample field. Five locations were sampled along each arm “W” pattern, giving total number 20 locations (Fig. 1). On a uniform field, the first encountered corner of the field was the starting point. One hundred paces along the field edge and 100 paces into the field marked the first weed counting site. 0.5 m x 0.5 m size quadrat was used. The distance between each quadrat depended upon the size and shape of the field and any obstructions that may have been present in the field. All weeds in each quadrat were identified, counted and recorded. Species that was not identified in the field was tagged and transported for later identification (Chancellor & Froud-Williams, 1982 & 84).

Care was taken to ensure that anomalies such as, shoulder and foot slopes, potholes, ditches, bluffs, power lines and paths was not sampled.

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

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

Where $F_k$ = frequency value for species k

$Y_i$ = presence (1) or absence (0) of species k in field i

$n$ = number of fields surveyed.

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

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

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

$n$ = number 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 quadrats.

$$D_{ki} = \frac{\sum_{1}^{20} Zi}{Ai}$$

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

$Z_i$ = number of plants of a species in quadrat j (a quadrat is $0.25^2$ m)

$A_i$ = area in $m^2$ of 20 quadrats in field i.

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

$$MFD_k = \frac{\sum_{1}^{n} Dki}{n}$$

Where $MFD_k$ = mean field density of species k

$D_{ki}$ = density (in numbers $m^{-2}$) of species k in field i
n = number of fields surveyed.

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.

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

Where $MOFD_k$=mean occurrence density of species k
$D_{ki}$ = density (in numbers $m^{-2}$) of species k in field I
n = number of fields surveyed
a = number 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 & 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 ($RF_k$):

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

Relative field uniformity for species k ($RFU_k$):

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

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

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

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 79 different weed species of which 43 were annuals and 36 were perennials, comprising 30 grasses, 17 sedges and 32 broadleaf weeds in different turfgrass areas (Table I). The annual species that was registered the greatest number than perennial (35) species but overall perennial grasses were more prevalent than annual grasses due to lack of satisfactory control measure either cultural or herbicide application. 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 16 families. The Poaceae family had the highest number of weed species (30), followed by Cyperaceae (17), Asteraceae (7), Rubiaceae (6), Euphorbiaceae (4), Fabaceae (3), Scrophulariaceae (3) and Commelinaceae (2). Rests of the 8 families were represented by one species each (Table I). Poaceae and Cyperaceae accounted together 59% of the species. Similarly, Xing *et al.* (2000) observed a more diversified 74 weed species belonging to 24 families were found in turf grass field in Hangzhou, China. However, in Brazil, floristic survey of weeds in lawns of *Paspalum notatum* under sunny and shade by crowns of trees represented by only 45 weed species distributed in 15 families of which Family Asteraceae, Poaceae, Cyperaceae, Euphorbiaceae and Fabaceae represent the greater number of species (Maciel *et al*., 2008). 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).

In terms of frequencies among the grasses the most common and frequent grass was *C. aciculatus* that occupied 28 turf fields (Table II). The next 10 other weeds that occurred in frequencies ≥20% were *I. indicum and Digitaria fusescens, C. dactylon* (common bermuda), *Eragrostis unioloides, Sporobolus diander Digitaria didactyla, Eluesine indica, Eragrostis viscosa, Eragrostis malayana* and *Eragrostis atrovirens*. Among the sedges the most

**Fig. 1. 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**

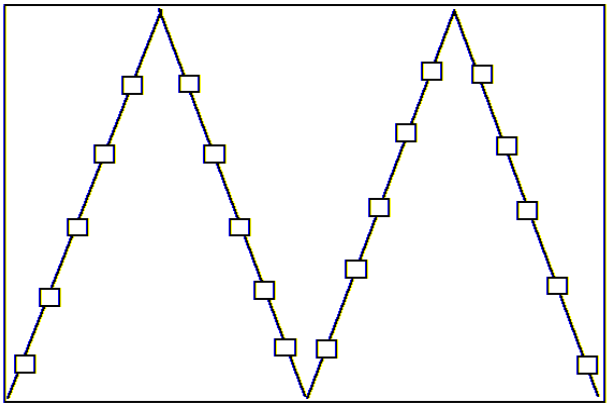

**Table I. Distribution of weed species based on family, scientific name, common name and life cycle (P= perennial, A= annual)**

| Family | Scientific name | Common name | Life cycle |
|---|---|---|---|
| **Grasses** | | | |
| Poaceae | *Axonopus affinis* Chase | Narrow leaf carpet grass | P |
| | *Bothrichloa intermedia* (R.Br.)A. Camus | Sandhor | P |
| | *Chrysopogon aciculatus* (Retz.)Trin. | Love grass | P |
| | *Cynodon dactylon* (L.) Pers. | Bermuda grass | P |
| | *C. dactylon* (L.) Pers. | Tifdwarf mutant | P |
| | *Dactyloctenium aegyptium* (L.) Beauv. | Egyptium fingergrass | A |
| | *Digitaria ciliaris* (Retz.) Koel | Common crubgrass | A |
| | *D. didactyla* Willd. | Serangoon grass | P |
| | *D. fuscescens* (J.Presl) Henr. | Yellow crabgrass | P |
| | *D. sanguinalis* (L.) Scop. | Hairy crabgrass | A |
| | *D. longiflora* (Retz.) Pers. | Indian crabgrass | P |
| | *Echinochloa colona* (L.) Link. | Jungle rice | A |
| | *Eleusine indica* (L.) Gaertn | Goosegrass | A |
| | *Eragrostis atrovirens* (Desv.) Trin. | Wiry eragrostis | P |
| | *E. malayana* Stapf. | Doubtfulgrass | A |
| | *E. viscosa* (Retz.) Trin. | Sticky love grass | P |
| | *E. tenella* (L.) Beauv. | Feathery eragrostis | A |
| | *E. unioloides* (Retz.) Nees | Chinese love grass | A |
| | *E. virescens* (J.Presl) | Mexican love grass | A |
| | *Imperata cylindrica* (L.) P.Beauv. | Swardgrass | P |
| | *Isachne globosa* (Thunb) O.Ktze. | Rounded Isachne | P |
| | *I. timorense* Kunth | Centipedegrass | A |
| | *I. indicum* (Houtt.) Merrill | Smut grass | P |
| | *I. muticum* L. | Drought grass | P |
| | *Leersia hyxandra* (L.) Sw. | Tigerstongul grass | P |
| | *Paspalum conjugatum* Berg. | Buffalo grass | P |
| | *Sacciolepis indica* (L.) A. Chase | Short spiked sacciolepis | A |
| | *Sporobolus diander* (Retz.) P.Beauv. | Lesser drop seed | P |
| | *S. indicus* (L.) R.Br. | Common drop seed | P |
| | *Stenotaphrum secundatum* (W. Kuntze) | St. Augustine | P |
| **Sedges** | | | |
| Cyperaceae | *Cyperus sphacelatus* Rottb. | Roadside flat sedge | A |
| | *C. aromaticus* L. | Greater kyllingia | P |
| | *C.perus compressus* L. | Hedgehog cyperus | A |
| | *C. distans* (L.) f. | Slender cyperus | P |
| | *C. eragrostis* Lamk. | Tall flat sedge | A |
| | *C. iria* L. | Grasshoppers cyperus | A |
| | *C. kyllingia* Endl. | White kyllingia | P |
| | *C. pilosus* Vahl | Fuzzy flat sedge | A |
| | *C. rotundus* L. | Purple nut sedge | P |
| | *Fimbristylis dichotoma* (L.) Vahl | Two leaf fimbry | P |
| | *F. diphylla* (Retz.) Vahl | - | A |
| | *F. globulosa* (Retz.) Kunth | Globe fimbristylis | P |
| | *F. miliacea* (L.) Vahl | Lesser fimbristylis | A |
| | *F. ovata* (Burm. f.) Kern | Common bird wing | A |
| | *F. pauciflora* R.Br. | flowered fimbristylis | A |
| | *Scirpus juncoides* (Roxb.) Palla | Rush hair sedge | A |
| | *S. latariflorus* G.F. Gmel | Scirpus | A |
| **Broadleaf weed** | | | |
| Acanthaceae | *Asytasia intrusa* Blume. | Common asystasia | A |
| Amaranthaceae | *Amaranthus virids* L. | Slender amaranth | A |
| Asteraceae | *Aegaratum conyzoides* L. | Goat weed | A |
| | *Eclipta prostata* L. | American false daisy | A |
| | *Emilia sonchifolia* (L.) DC. | Purple sowthistle | A |
| | *Eupatorium odoratum* L. | Siam weed | A |
| | *Tridax procumbens* L. | Coat buttons | P |
| | *Vernonia cineria* (L.) Less. | Little iron weed | P |
| | *Youngia japonica* Benth. (L.) DC. | False hawskbeard | P |
| Capparidaceae | *Cleome rutidosperma* DC. | Yellow cleome | A |
| Commelinaceae | *Commelina nudiflora* L. | Day flower | A |
| Convolvulaceae | *Ipomoea triloba* L. | Little bell | A |
| Euphorbiaceae | *Euphorbia hirta* L. | Hairy spurge | A |

Table I. Continued

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| | | | |
|---|---|---|---|
| | *E. thymifolia L.* | Thyme leaf spurge | A |
| | *Phyllanthus niruri* L. | Sleeping plant | A |
| | *P. urinaria* L. | Chamber bitter | A |
| Fabaceae | *Desmodium ovalifolium (*Prain) Wall. | Ovalifolium | P |
| | *D. triflorum* (L.) DC. | Three flower ticktrefoil | P |
| | *D. heteropyllum* (Willd.) DC. | Desmodium | P |
| Mimosaceae | *Mimosa pudica* L. | Sensitive plant | P |
| Onagraceae | *Jussiaea linifolia* Vahl | Narrowleaved willow herb | A |
| Piperaceae | *Peperomia pellucida* (L.) Kunth. | Shiny bush | A |
| Portulacaceae | *Portulaca oleracae* L. | Pig weed | A |
| Rubiaceae | *Borreria latifolia* Schum. | Broadleaf button weed | P |
| | *B. repens* DC. | False button weed | A |
| | *B. setidens* (Miq.) Bold. | Toothed button weed | A |
| Rubiaceae | *Hedyotis corymbosa* (L.) Lamk | Two flowered oldenlandia | A |
| | *H. verticillata* (L.) Lam. | Woody borreria | P |
| | *Oldenlandia dichotoma* A.Rich. var. | Many flowered oldenlandia | A |
| Scrophulariaceae | *Lindernia grandiflora* Nutt. | Savannah false pimpernel | A |
| | *L. crustacea* (L.) F. Muell. | Malaysian false pimpernel | P |
| | *Scoparia dulcis* L. | Sweet broom weed | A |

wide spread weed species in terms of frequencies was *C. aromaticus* followed by the other weeds that occurred ten or more than ten fields were *F. dichotoma, F. globulosa, C. compressus, C. kyllingia and C. rotundus*. In broadleaves the most frequent weed species was *D. triflorum* along with the other weeds that frequencies ≥20% were *B. repens, Lindernia crustacea, Borreria latifolia, Phyllanthus urinaria, Euphorbia thymifolia* and *Hedyotis corymbosa*. Frequencies of the remaining grasses, sedges and broadleaves were 2 to 18%, 2 to 14% and 2 to 8%, respectively (Table II). Uniformity is a quantitative measure of the spread of a weed species within a given field. For example grasses *C. aciculatus, I. indicum*, *D. fusescens, C. dactylon* (common bermuda), *Eragrostis malayana* sedges: *C. aromaticus* and *F. dichotoma and* broadleaves *D. triflorum, B. repens and L. crustacea* were uniformly distributed throughout the fields (Table II).

*C. aromaticus* was the most abundant weed with a density of 53.50 plants $m^{-2}$. *F. dichotoma* was second most abundant weed with a density 32.20 plants $m^{-2}$. *I. indicum, D. fusescens*, *C. aciculatus*, *F. globulosa* and *D. triflorum* were other weeds that densities had over 9 plants $m^{-2}$ (Table II). 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 most of the grasses, sedges and broadleaf such as *E. uniloides*, *F. globulosa*, *C. compressus* and *E. thymifolia* 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. In addition, some of the very less frequent grasses *C. dactylon* (tifdwarf mutant) and *Stenotaphrum secundatum* and one sedge *Fimbristylis diphylla* had a much higher MOFD than MFD, suggesting that these weeds flourished in the particular site specific, their overall contribution to the weed flora in turf fields was minimal. 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 type of weeds that have field frequencies less than 20%, field uniformities less than 2 and mean field densities less than 9 plants $m^{-2}$ may either less competitive with turf or may be effectively controlled by current weed management practice in turf area.

For brevity, only the species that appeared in ten or more fields were ranked according to relative abundance (RA) value (Table III). Among these species 11 grasses, 6 sedges and 7 were broadleaf weeds accounted for 80% 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 *C. aromaticus, F. dichotoma, D. triflorum, I. indicum, C. aciculatus, B. repens, D. fuscescens, L. crustacea, C. dactylon* (common bermuda) and *E. malayana,* The respective RA values for these weed species were 37.66, 28.12, 16.55, 13.24, 12.45, 12.00, 11.62, 10.88, 10.05 and 8.98, respectively (Table III). In this study most of the abundant weeds were perennial in nature. It might be due to their compatible environment of cultivated perennial turf grasses.

Generally the turf weeds are those species that are specially adapted in some way to the continuous defoliation experienced in a turf area and well-suited in that environment. Although 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 *C. aciculatus* the higher RA value reflects it respective higher values of frequency (F), field uniformity (FU) and mean field density (Tables II and III). Even though, *C. aromaticus* followed by *F. dichotoma* consistently were top two abundant species irrespective of frequency (F), field uniformity (FU) and mean field density (MFD) or mean occurrence field density (MOFD).

**Table II. Frequency (F), field uniformity (FU), Mean field density (MFD), and mean occurrence field density (MOFD) of weeds in turfgrass area of West Peninsular Malaysia**

| Scientific name | F (%) | FU (%) | MFD ($m^{-2}$) | MOFD($m^{-2}$) |
|---|---|---|---|---|
| **Grasses** | | | | |
| *Chrysopogon aciculatus* | 56 | 10.70 | 9.79 | 17.49 |
| *Ischaemum indicum* | 44 | 10.90 | 13.90 | 31.60 |
| *Digitaria fuscescens* | 40 | 9.10 | 12.38 | 30.96 |
| *Cynodon dactylon* (common bermuda) | 38 | 9.20 | 8.78 | 23.12 |
| *Eragrostis malayana* | 34 | 7.60 | 8.43 | 24.80 |
| *Sporobolus diander* | 30 | 4.90 | 1.90 | 6.35 |
| *D. didactyla* | 26 | 7.10 | 4.64 | 17.85 |
| *Eleusine indica* | 26 | 4.10 | 2.35 | 9.05 |
| *E. viscosa* | 24 | 3.20 | 0.70 | 2.93 |
| *E. unioloides* | 22 | 8.20 | 9.92 | 45.09 |
| *E. atrovirens* | 20 | 1.90 | 2.19 | 15.66 |
| *Bothrichloa intermedia* | 18 | 2.40 | 1.06 | 5.87 |
| *Axonopus affinis* | 14 | 2.40 | 1.81 | 12.91 |
| *S. indicus* | 14 | 1.50 | 0.94 | 4.72 |
| *Paspalum conjugatum* | 10 | 0.60 | 0.22 | 2.24 |
| *D. ciliaris* | 10 | 1.00 | 0.22 | 2.24 |
| *C. dactylon* (tifdwarf mutant) | 8 | 3.20 | 2.77 | 34.60 |
| *I. muticum* | 8 | 0.8 | 0.62 | 7.80 |
| *Stenotaphrum secundatum* | 6 | 3.20 | 2.54 | 42.40 |
| *I. timorense* | 6 | 0.90 | 0.91 | 15.20 |
| *Dactyloctenium aegyptium* | 6 | 0.80 | 0.37 | 6.13 |
| *Isachne globosa* | 6 | 0.60 | 0.10 | 1.60 |
| *Imperata cylindrica* | 6 | 0.50 | 0.21 | 3.47 |
| *Echinochloa colona* | 6 | 0.50 | 0.13 | 2.13 |
| *E. tenella* | 6 | 0.50 | 0.14 | 2.40 |
| *Sacciolepis indica* | 4 | 0.40 | 0.21 | 5.20 |
| *E. virescens* | 4 | 0.30 | 0.06 | 1.07 |
| *Leersia hyxandra* | 4 | 0.30 | 0.13 | 3.20 |
| *D. longiflora* | 4 | 0.20 | 0.08 | 2.00 |
| *D. sanguinalis* | 2 | 0.10 | 0.11 | 5.60 |
| **Sedges** | | | | |
| *Cyperus aromaticus* | 70 | 27.7 | 53.50 | 76.43 |
| *Fimbristylis dichotoma* | 66 | 26.0 | 32.16 | 48.73 |
| *F. globulosa* | 26 | 7.30 | 9.20 | 35.38 |
| *C. compressus* | 24 | 5.40 | 5.38 | 22.40 |
| *C. kyllingia* | 20 | 2.10 | 2.13 | 10.64 |
| *C. rotundus* | 20 | 3.00 | 3.06 | 15.28 |
| *F. ovata* | 14 | 3.30 | 1.92 | 13.71 |
| *C. sphacelatus* | 14 | 2.60 | 1.79 | 12.80 |
| *C. distans* | 10 | 1.10 | 1.78 | 17.76 |
| *F. miliacea* | 8 | 1.40 | 0.59 | 7.40 |
| *F. pauciflora* | 6 | 1.10 | 0.99 | 16.53 |
| *C. iria* | 6 | 0.80 | 0.19 | 3.20 |
| *F. diphylla* | 6 | 0.60 | 2.54 | 42.40 |
| *Scirpus juncoides* | 4 | 0.40 | 0.19 | 4.80 |
| *S. latariflorus* | 4 | 0.40 | 0.14 | 3.60 |
| *C. eragrostis*. | 4 | 0.50 | 0.24 | 6.00 |
| *C. pilosus* | 2 | 0.10 | 0.03 | 1.60 |
| **Broadleaf weeds** | | | | |
| *Desmodium triflorum* | 64 | 20.10 | 9.66 | 15.10 |
| *Borreria repens* | 54 | 12.0 | 7.82 | 14.49 |
| *Lindernia crustacea* | 48 | 11.40 | 6.77 | 14.10 |
| *B. latifolia* | 36 | 3.30 | 2.70 | 7.51 |
| *Phyllanthus urinaria* | 28 | 5.40 | 3.57 | 12.74 |
| *Euphorbia thymifolia* | 26 | 4.40 | 3.73 | 20.71 |
| *Hedyotis corymbosa* | 20 | 2.90 | 2.58 | 12.88 |
| *Oldenlandia dichotoma* | 16 | 2.60 | 1.78 | 7.40 |
| *E. hirta* | 16 | 2.10 | 0.74 | 4.60 |
| *Emilia sonchifolia* | 16 | 1.20 | 1.17 | 7.30 |
| *Tridax procumbens* | 14 | 1.20 | 0.66 | 4.69 |
| *Commelina nudiflora* | 12 | 1.30 | 0.66 | 5.47 |
| *Mimosa pudica* | 12 | 1.30 | 0.48 | 4.00 |

Table II. Continued

**Table II. Continued**

| | | | | |
|---|---|---|---|---|
| *D. ovalifolium* | 12 | 0.80 | 0.54 | 4.53 |
| *P. niruri* | 10 | 0.90 | 0.61 | 6.08 |
| *Cleome rutidosperma*. | 10 | 0.60 | 0.13 | 1.28 |
| *Vernonia cineria* | 8 | 0.50 | 0.14 | 1.80 |
| *Desodium heteropyllum* | 6 | 0.90 | 0.35 | 5.87 |
| *Aegaratum conyzoides* | 6 | 0.50 | 0.21 | 3.47 |
| *Eclipta prostata* | 6 | 0.70 | 0.16 | 2.67 |
| *Asytasia intrusa*. | 6 | 0.40 | 0.10 | 1.60 |
| *P. oleracae* | 6 | 0.40 | 0.14 | 2.40 |
| *Peperomia pellucida* | 6 | 0.40 | 0.13 | 2.13 |
| *Youngia japonica* | 6 | 0.30 | 0.10 | 1.60 |
| *Hedyotis verticillata* | 6 | 0.30 | 0.11 | 1.87 |
| *Amaranthus virids* | 4 | 0.40 | 0.10 | 2.40 |
| *Borreria setidens* | 4 | 0.40 | 0.08 | 2.00 |
| *Jussiaea linifolia* | 4 | 0.30 | 0.05 | 1.20 |
| *Lindernia grandiflora* | 4 | 0.20 | 0.06 | 1.60 |
| *Scoparia dulcis* | 2 | 0.20 | 0.21 | 10.40 |
| *Eupatorium odoratum* | 2 | 0.30 | 0.06 | 3.20 |
| *Ipomoea triloba* | 2 | 0.20 | 0.05 | 2.40 |

**Table III. Relative abundance of grasses, sedges and broadleaf weeds that occurred in ten or more fields in West Peninsular Malaysia**

| *Scientific name* | *Relative abundance* | *Weed type* |
|---|---|---|
| *C. aromaticus* L. | 37.66 | Sedge |
| *F. dichotoma* (L.) Vahl | 28.12 | Sedge |
| *D. triflorum* (L.) DC. | 16.65 | Broadleaf |
| *Ischaemum indicum* (Houtt.) Merrill | 13.24 | Grass |
| *Chrysopogon aciculatus* (Retz.)Trin. | 12.45 | Grass |
| *Borreria repens* DC. | 12.00 | Broadleaf |
| *D. fuscescens* (J.Presl) Henr. | 11.62 | Grass |
| *Lindernia crustacea* F. Muell. | 10.88 | Broadleaf |
| *C. dactylon* (common bermuda) | 10.05 | Grass |
| *E. malayana* Stapf. | 8.98 | Grass |
| *E. unioloides*(Retz.) Nees | 8.87 | Grass |
| *F. globulosa* (Retz.) Kunth | 8.55 | Sedge |
| *D. didactyla* Willd. | 6.64 | Grass |
| *C. compressus* L. | 6.12 | Sedge |
| *P. urinaria* L. | 5.71 | Broadleaf |
| *E. thymifolia* L. | 5.23 | Broadleaf |
| *B. latifolia* Schum. | 5.18 | Broadleaf |
| *S. diander* (Retz.) P.Beauv. | 5.01 | Grass |
| *E. indica* (L.) Gaertn | 4.56 | Grass |
| *C. rotundus* L. | 3.95 | Sedge |
| *H. corymbosa* (L.) Lamk | 3.72 | Broadleaf |
| *E. viscosa* (Retz.) Trin. | 3.40 | Grass |
| *C. kyllingia* Endl. | 3.23 | Sedge |
| *E. atrovirens* (Desv.) Trin. | 3.18 | Grass |

This result indicates that *C. aromaticus* and *F. dichotoma* are clearly the most important two sedges in turf grass areas. The two other grasses *I. indicum, C. aciculatus* and two broadleaves *D. triflorum* and *B. repens* 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, Moody and Drost (1983) observed that the dominant weed flora in any crop field is usually about ten species of which the dominant ones rarely are more than 3 to 4. 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.

## CONCLUSION

A useful feature of the survey system was the method of ranking species based on relative abundance values. This survey provides the first quantitative comparison of the common species. Among the 10 abundant species two sedges viz. *C. aromaticus* and *F. dichotoma* were the most abundant weeds in turf grass areas followed by *D. triflorum* and two grassy weeds *I. indicum*, *C. aciculatus* and broadleaf weed *B. repens* were the worst weed found turf grass areas in Malaysia and competes readily with turf grass species. 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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