

Contents

Abstract	i
Acknowledgements	iii
Contents	iv
List of Tables	viii
List of Figures	x
List of Abbreviations	xi
CHAPTER 1 . INTRODUCTION	1
1.1 World status of rice and weedy rice: origin and occurrence	1
1.2 General morphological and physiological features	1
1.3 Origin and occurrence of weedy rice in Sri Lanka	2
1.4 Objectives	3
2 REVIEW OF LITERATURE	4
2.1 Rice	4
2.1.1 Taxonomy	4
2.1.2 Origin and distribution of rice plant	5
2.1.3 Morphology	6
2.1.4 Growth and Development	6
2.1.4.1 Germination and vegetative growth stage	6
2.1.4.2 Reproductive growth stage	6
2.1.4.3 Maturity stage	7
2.2 Rice in Sri Lanka	7
2.3 Agro-ecological zones of Sri Lanka	8
2.3.1 Performance of cultivated rice in different Agro-ecological zones	9
2.3.2 Impact of weeds on rice production	10
2.4 Weedy Rice	12

2.4.1	Characteristics of weedy rice	13
2.4.2	Competitive characteristics of weedy rice	13
2.4.2.1	Seed shattering	13
2.4.2.2	Seed dormancy	14
2.4.2.3	Vigor and competitiveness	15
2.4.2.4	Plant height	15
2.4.2.5	Tillers	15
2.4.2.6	Germination	16
2.4.3	Sources of contamination of cultivated rice with weedy rice	16
2.4.4	Weedy rice problem in the world	16
2.4.4.1	Asia	16
2.4.4.2	America	17
2.4.4.3	Southern Europe and the Mediterranean countries	17
2.4.4.4	Africa	18
2.4.5	Status of weedy rice in Sri Lanka	18
2.4.6	Management of weedy rice	18
2.4.7	Importance of weedy rice	19
2.5	Origin of weedy rice and its genetic variability	20
2.5.1	Origin of weedy rice	20
2.5.2	Genetic variability, heritability and genetic advance	21
3	MATERIALS AND METHODS	22
3.1	Morphological screening of weedy rice	22
3.1.1	<i>In-situ</i> morphological characterization	22
3.1.1.1	Density and distribution of weedy rice in Matara district	24
3.1.1.2	Data Analysis	24
3.1.2	<i>Ex-situ</i> morphological characterization of weedy rice	24
3.1.2.1	Collection of weedy rice samples	24
3.1.2.2	Morphological screening of weedy rice	26
3.1.2.3	Collection of experimental data	28
3.1.2.4	Characteristics recorded	28
3.1.2.5	Seed germinating ability of weedy rice	30
3.1.3	Data Analysis	30

4	RESULTS AND DISCUSSION	34
4.1	Weedy rice distribution in Sri Lanka	34
4.2	<i>In-situ</i> morphological characterization of weedy rice	36
4.2.1	Morphological variations of weedy rice accessions between districts	36
4.2.2	Morphological variations of weedy rice accessions within districts	37
4.2.2.1	Variation of the morphological characteristics within Ampara district	37
4.2.2.2	Variation of the morphological characteristics within Puttalam district	37
4.2.2.3	Variation of the morphological characteristics within Kurunegala district	38
4.2.2.4	Variation of the morphological characteristics within Polonnaruwa district	38
4.2.2.5	Variation of the morphological characteristics within Auradhapura district	39
4.2.2.6	Variation of the morphological characteristics within Matara district	39
4.2.3	Variation of the qualitative awn characteristics among districts and locations	40
4.3	Density and distribution pattern of weedy rice in Matara district	44
4.3.1	Results of questionnaire survey	45
4.4	<i>Ex-situ</i> morphological characterization of weedy rice	46
4.5	Genetic variability and diversity	50
4.5.1	Analysis of variance	50
4.5.2	Genetic variability, heritability and genetic advance	52
4.5.3	Morphological Correlations among characteristics	54
4.5.4	Analysis of the variables by the Principal component analysis (PCA)	56
4.5.5	Cluster Analysis	57
4.6	Morphological characterization of weedy rice accessions based on different Agro-Ecological Zones (AEZ) of Sri Lanka	61
4.6.1	Plant height	64
4.6.2	Number of tillers and time of flowering	65
4.6.3	Number of panicles per plant	66
4.6.4	Panicle length	67
4.6.5	Shattering percentage and the number of filled seeds per panicle	68

4.6.6	Number of seeds per panicle and per plant	68
4.6.7	Seed length and seed width	68
4.6.8	1000 seed weight	68
4.7	Ranges of the <i>ex-situ</i> morphological characteristics of weedy rice accessions in AEZs	69
4.7.1	Principal component analysis showing the contribution of each characteristic among different locations in Agro-Ecological Zones (AEZ) of Sri Lanka	71
4.8	Seed germination differences of weedy rice accessions	74
4.8.1	Variation of seed germination at Anuradhapura	74
4.8.2	Variation of seed germination at Puttlam	75
4.8.3	Variation of seed germination at Ampara	76
4.8.4	Variation of seed germination at Matara	77
4.8.5	Variation of seed germination at Polonnaruwa	77
4.8.6	Variation of seed germination at Kurunegala	78
4.9	Variation among qualitative characteristics of weedy rice	79
4.9.1	Stem color	79
4.9.2	Seed pigmentation	81
4.9.3	Presence of awns and awn size and color	83
5	CONCLUSION	88
6	REFERENCES	90
7	APPENDIX	100

List of Tables

Table 3.1 : The coordinates of the selected locations used for the in-situ morphological study of weedy rice	23
Table 3.2 : The selected locations used for the ex-situ morphological study of weedy rice	25
Table 3.3: Analysis of variance	31
Table 4.1 : Variation of plant height (PH), panicle length (PL), number of tillers (TN) and number of panicles (PN) per plant and the Leaf length (LL) among districts	36
Table 4.2 : Variation of morphological characteristics among locations within Ampara district.	37
Table 4.3 : Variation of the morphological characteristics among locations within Puttlam district	37
Table 4.4: Variation of the morphological characteristics among locations within Kurunegala district	38
Table 4.5 : Variation of the morphological characteristics among locations within Polonnaruwa district	38
Table 4.6 : Variation of the morphological characteristics among locations within Anuradhapura district	39
Table 4.7 :Variation of the morphological characteristics among locations within Matara district	39
Table 4.8 : Variability of the qualitative awn characteristics among districts and locations	40
Table 4.9 : Summary of the within district ranges of quantitative and qualitative characteristics of weedy rice	43
Table 4.10 : Total number of germinated weedy rice accessions and their locations and the accession numbers.	47
Table 4.11 : Means and variations of the quantitative morphological characteristics of the weedy rice accessions	49
Table 4.12 : Analyses of variance for different characteristics of weedy rice	51
Table 4.13 : Genetic parameters of weedy rice characteristics	53
Table 4.14 : Correlation coefficients among the 13 morphological characteristics of weedy rice	55
Table 4.15 : Principal Components (PCs), eigen vectors and percentage total variance accounted for by PCs	56

Table 4.16 : Individual weedy rice accessions in each cluster	58
Table 4.17 : Means of five clusters based on 13 quantitative characteristics in 370 weedy rice accessions	59
Table 4.18 : Contribution of the number of accessions from different locations for the different clusters	60
Table 4.19 : Means of the quantitative morphological characteristics of weedy rice accessions in different locations	62
Table 4.20 : Ranges of the ex-situ morphological characteristics of weedy rice in different Agro-ecological Zones	70
Table 4.21 : Eigen values and cumulative % variance explained by selected four principal components	72
Table 4.22 : Loading of quantitative characteristics into principal components (PCs) with scores	72
Table 4.23 : Stem color variation in weedy rice among locations	80
Table 4.24 : Presence of seed pigmentation in weedy rice in different locations	82
Table 4.25 : Variation of the length and color of the awn in weedy rice at different locations	87

List of Figures

Figure 2.1 Evolutionary pathway of the two cultivated species of rice.	5
Figure 2.2 : Agro-ecological Zones of Sri Lanka.	11
Figure 3.1: Seedlings of the germinated seeds in transparent dishes	26
Figure 3.2 : Land preparation	27
Figure 3.3 : Seedling transplanting in the field.	27
Figure 4.1 : Map of the locations where weedy rice was collected	35
Figure 4.2 : Density and distribution pattern of weedy rice in selected locations in Matara district (a) 2009 (b) 2010	45
Figure 4.3 : Principal Component Analysis	57
Figure 4.4 : Variation of plant height of the weedy rice accessions and their canopy structures.	64
Figure 4.5 : Variation of the tiller number among weedy rice accessions	65
Figure 4.6 : Variation of the flowering among weedy rice accessions	66
Figure 4.7 : Variation of the number of panicles per plant among weedy rice accessions	67
Figure 4.8 : Variation in the panicle length among weedy rice accessions	67
Figure 4.9 : Dendrogram obtained through Hierarchical Cluster Analysis (Ward Method) based on the principal components	73
Figure 4.10 : Variation of seed germination at Anuradhapura	75
Figure 4.11 : Variation of seed germination at Puttalam	76
Figure 4.12 : Variation of seed germination at Ampara	76
Figure 4.13 : Variation of seed germination at Matara	77
Figure 4.14 : Variation of seed germination at Polonnaruwa	78
Figure 4.15 : Variation of seed germination at Kurunegala	78
Figure 4.16 : Percentages of the different stem colors in weedy rice among districts	79
Figure 4.17 : Variation in the stem color among weedy rice accessions	80
Figure 4.18 : Variation of the seed coat color of weedy rice	82
Figure 4.19 : Percentages of presence or absence of awns in weedy rice among districts	82
Figure 4.20 : Variation in presence of awns and their lengths in weedy rice	84
Figure 4.21: Percentage of the presence or absence of awn in weedy rice in different districts	84
Figure 4.22 : Variation in the awn size among seeds of different weedy rice accessions	85
Figure 4.23: Variation in the awn color among weedy rice accessions	86