

TABLE OF CONTENTS

ACKNOWLEDGEMENT	i
TABLE OF CONTENTS	ii
LIST OF TABLES	vi
LIST OF FIGURES	viii
LIST OF PLATES.....	x
ABSTRACT.....	xi
CHAPTER ONE	
INTRODUCTION.....	01
OBJECTIVES OF THE STUDY.....	06
CHAPTER TWO	
LITRATURE REVIEW	07
2.1 The need for increasing food productivity	06
2.2 Issues associated with present day agriculture (Conventional agriculture).....	09
2.3 Solutions from nano technology for issues in conventional agriculture.....	10
2.4 Nano technology.....	11
2.5 Nano fertilizer	12
2.6 Foliar application of nano fertilizer	12
2.7 Nano fertilizer applications in agriculture.....	13
2.8 Advantage of Nano fertilizer over conventional fertilizer	16

2.9 Nano calcite (calcium carbonate) formulation and application.....	17
2.10 Some observations of use of herbagreen nano calcium carbonate.....	19
2.11 Rice cultivation and production in Sri Lanka.....	23
2.11.1 Field preparation	24
2.11.2 Varietal selection	26
2.11.3 Water management	27
2.11.4 Weed management	28
2.11.5 Seed rate	29
2.11.6 Soil fertility improvement and sustenance	29
2.11.7 Insect, pest and diseases management	30

CHAPTER THREE

MATERIALS AND METHODS.....	32
3.1 Experimental site.....	32
3.2 Planting material.....	32
3.3 Nano calcium carbonate levels.....	33
3.4 Soil fertilizer levels.....	33
3.5 Experiment 01- Pilot pot experiment.....	35
3.6 Experiment 02 - Field experiment.....	35
3.7 Experiment 03- Pot experiment.....	37
3.8 Data collection.....	37

3.8.1 Measurement of leaf area & flag leaf area per plant	38
3.8.2 Number of leaves per plant	39
3.8.3 Plant height	39
3.8.4 Chlorophyll content	40
3.8.5 Thousand grain weight	40
3.8.6 Time taken to 50% flowering	40
3.8.7 Number of seeds per panicle	41
3.8.8 Root volume and root length	41
3.8.9 Insect resistant/count	41
3.8.10 Brown rice percentage and rice husk weight	42
3.8.11 Total milling rice percentage and rice bran weight	43
3.8.12 Head grains percentage	43
3.8.13 Length and width of grain with husk	44
3.8.14 Shoot dry weight and shoot dry weight	44
3.9 Analysis of soil parameters	46
3.9.1 Determination of soil organic matter content.....	46
3.9.2 Determination of soil pH Value	47
3.9.3 Determination of electrical conductivity (EC)	47
3.9.4 Determination of soil Texture	48
3.10 Data analysis	48

CHAPTER FOUR

RESULTS AND DISCUSSION.....	49
4.1 Pilot pot experiment.....	49
4.2 Field and pot experiment	60

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS	91
---------------------------------------	----

CHAPTER SIX

REFERENCES	92
------------------	----

APPENDIX

Appendix 1	105
Appendix 2	110
Appendix 3	112

LIST OF TABLES

Table 2.1 ANOVA result in seed production of cucumber (Variety Kiara) with HB application.....	19
Table 2.2 Variation of potato yield with application herbagreen.....	20
Table 2.3 Variability of plant density during harvest, yield, and quality of roots with application of harbagreen nano calcium carbonate in 2011-2012	21
Table 2.4 Effect of foliar fertilizer application on tomato and yield parameters variation	22
Table 2.5 Effect of foliar fertilizer application on tomato and insect controlling	22
Table 2.6 Major rice productive seasons of Sri Lanka	23
Table 2.7 Major rice productive provinces of Sri Lanka	24
Table 2.8 Examples of some rice varieties released by department of Agriculture with different types of qualities and yield	26
Table 3.1 Nano calcium carbonate application volumes per pot	33
Table 3.2 Recommended fertilizer levels for rice in Sri Lanka (Kg/ha)	34
Table 3.3 Soil fertilizer levels applied for pilot pot experiment, second pot experiment and field trial	34
Table 3.4 Plant growth, yield and seed quality parameters recorded throughout this study.....	37
Table 4.1 Effect of the nano calcium carbonate levels on growth parameters of pilot pot experiment	52
Table 4.2 Effect of the nano calcium carbonate on yield and quality parameters of pilot pot experiment	53
Table 4.3 Effect of the NCC application and insect count/damage days after transplanting in 2015 <i>Yala</i> season	55

Table 4.4 Pilot pot experiment – Correlation among each parameter	58
Table 4.5 Variation of growth parameters after 30 days with NCC treatment of field experiment	62
Table 4.6 Variation of growth parameters after 30 days with NCC treatment of pot experiment	63
Table 4.7 Variation of growth parameters after 60 days with NCC treatment of field experiment	64
Table 4.8 Variation of growth parameters after 60 days with NCC treatment of pot experiment	65
Table 4.9 Variation of growth parameters after 90 days with NCC treatment of field experiment	66
Table 4.10 Variation of growth parameters after 90 days with NCC treatment of pot experiment	67
Table 4.11 Variation of some growth parameters with recommended soil fertilizer levels and foliar NCC levels after 60 days	68
Table 4.12 Interaction of NCC levels and soli fertilizer levels for leaf area development and tiller development in field trial	69
Table 4.13 Interaction of NCC levels and soli fertilizer levels for root volume development and shoot height development in field trial	70
Table 4.14 Field experiment – Correlations among each parameter	89

LIST OF FIGURES

Figure 4.1 Variation of shoot height with effect of different levels of NCC in (A); 30, (B); 60 and 90 days after transplanting	50
Figure 4.2 Time taken for 50% flowering with effect of different levels of NCC	54
Figure 4.3 Paddy yield variation per pot with effect of different NCC concentrations and different soil fertilizer levels	56
Figure 4.4 Simple correlation of pilot pot experiment	57
Figure 4.5 Effect of different levels of NCC on 50% flowering in (A) field experiment, (B) pot experiment	71
Figure 4.6 Variation of grain yield in field experiment with effect of different NCC levels and different soil fertilizer levels (A) <i>Maha</i> season in 2015/16 and (B) <i>Yala</i> seasons in 2016	74
Figure 4.7 Variation of grain yield of pot experiment with effect of different levels of NCC in harvesting stage (<i>Maha</i> (A) & <i>Yala</i> (B) season in 2016)	75
Figure 4.8 Variation of panicle length of rice with effect of different NCC levels and different soil fertilizer levels	76
Figure 4.9 Variation of filled grain amount per panicle with effect of different NCC levels – 2015 <i>Maha</i> (A) & 2016 <i>Yala</i> (B) in field experiment	77
Figure 4.10: Variation of number of panicles per plant with effect of different NCC levels– 2015/16 <i>Maha</i> (A) & 2016 <i>Yala</i> (B) in field experiment	78
Figure 4.11 Variation of brown rice percentage	79
Figure 4.12 Variation of 1000 polished rice weight (A) and 1000 paddy grains weight (B) with different NCC levels in 2015/16 <i>Maha</i> and 2016 <i>Yala</i> season in field experiment	80
Figure 4.13 Variation of rice grain length with husk (A) and rice grain length without husk (B) with different NCC levels in 2015/16 <i>Maha</i> and 2016 <i>Yala</i> season in field experiment	81
Figure 4.14 Variation of rice grain width with husk (A) and rice grain width without husk (B) with different NCC levels in 2015/16 <i>Maha</i> and 2016 <i>Yala</i> season in field experiment	82

Figure 4.15 Leaf folder damage – A, Gall midge count - B and Leaf mites count -C with effect of different NCC levels after 60 days	84
Figure 4.16 Stem borer white heads count -A and Leaf mites count - B with effect of different NCC levels after 90 days	86
Figure 4.17 The simple leaner correlations, growth parameters vs NCC levels	87

LIST OF PLATES

Plate 1.1 A schematic diagram of Nano particles of CaCO ₃ entering into plant leaves through the stomata	02
Plate 1.2 Electron microscopic view of crystal form of calcium carbonate and nano sized calcium carbonate particles	03
Plate 1.3 Behavior of stomata after spraying nano calcium carbonate	03
Plate 2.1 The projected world population in 2015.....	07
Plate 2.2 The variation of global arable land/global crop production	08
Plate2.3 (A) Tribo mechanical activator (B) activator plates and (C) samples of pulverized calcite.....	17
Plate 3.1 Various steps of establishing seedling nurseries	32
Plate 3.2 Establishment of experimental unit of pilot experiment	35
Plate 3.3 Field layout and arrangement of plots of the field experiment	36
Plate 3.4 Counting of leaves per plant	39
Plate 3.5 Colour chart used for chlorophyll content determinations	40
Plate 3.6 (A) Some rice grain samples collected from different experimental plots and (B) Rice husker (SATAKE – THU 358) used in this experiment	42
Plate 3.7 (A) Preparation of dry plant sample (B) Preparation of shoot sample (C)Dry weight measuring of plant (root and shoot)	45
Plate 4.1 Variation of plant height, root growth and number of tillers per plant with different NCC levels	51