

## CONTENTS

	Page
1. INTRODUCTION .....	1
2. REVIEW OF LITERATURE .....	3
2.1- Function of sprayers .....	3
2.2- Chemical-spraying applications .....	4
2.3- Factors affecting performance of sprayers .....	7
2.3.1- Drop size .....	7
2.3.2- Quantitative examination and distribution efficiency .....	13
2.3.3- Productivity and efficiency .....	20
2.4- Cost analysis and economic evaluation .....	23
2.5- System approach to agricultural mechanization problems .....	27
3. MATERIALS AND METHODS .....	28
3.1- General scope of work .....	28
3.2- Types of spraying equipment .....	28
3.2.1- Knapsack sprayer hand operator .....	28
3.2.2- Knapsack air-carrier sprayer .....	31
3.2.3- Stationary field sprayer .....	31
3.2.4- Mounted boom field sprayer .....	31
3.3- Experimentation .....	38
3.4- Collection, measurement and assessment of droplets .....	39
3.4.1- Collection and determination of spray distribution .....	39
3.4.2- Determination of droplets/cm <sup>2</sup> and the volume median diameter .....	39
3.5- Economical evaluation measurements .....	40

3.6- Computer description .....	42
3.7- Systems approach analysis.....	43
3.8- Flow chart of program .....	46
<b>4. RESULTS AND DISCUSSION .....</b>	<b>48</b>
4.1- Evaluation of different systems under study .....	48
4.1.1- Comparison between the systems under study and their components of production time ....	48
4.1.2- The relation between spraying forward speed and efficiency .....	50
4.1.2.1- The relation between forward speed and efficiency for knapsack hand-sprayer .....	50
4.1.2.2- The relation between forward speed and efficiency for knapsack air-carrier spraying .....	53
4.1.2.3- The relation between forward speed and efficiency for stationary field sprayer..	54
4.1.2.4- The relation between forward speed and efficiency for mounted boom field sprayer.	57
4.2- Actual productivity for the systems under study...	59
4.3- Distribution uniformity of sprayers .....	61
4.3.1- Distribution of droplets (No./cm <sup>2</sup> ) for knapsack hand-sprayer .....	61
4.3.2- Distribution of droplets (No./cm <sup>2</sup> ) for knapsack air-carrier sprayer .....	63
4.3.3- Distribution of droplets (No./cm <sup>2</sup> ) for stationary field sprayer .....	65
4.3.4- Distribution of droplets (No./cm <sup>2</sup> ) for mounted boom field-sprayer .....	67
4.3.5- Comparison between the four spraying system at the three portions of plant for both sides of leaves .....	69
4.4- Covering efficiency for systems under study .....	72
4.5- The operation cost of spraying machines .....	74
4.5.1- Machine cost .....	74
4.5.2- Comparison between systems under study and their seasonal operation cost .....	76

4.5.3-	Relation between system under study and their cost L.E/h and seasonal operating cost LE.....	78
4.6-	The increase in cotton yield and economical advantage criterion .....	80
4.6.1-	Increase in cotton yield as related to systems under study .....	80
4.6.2-	Economical advantage criterion and systems under study .....	82
4.6.3-	Modeling for optimum productivity, operation cost, and economical advantage criterion ....	84
5.	SUMMARY AND CONCLUSION .....	86
6.	REFERENCES .....	88
7.	APPENDIX .....	96
8.	ARABIC SUMMARY .....	

## LIST OF TABLES

	Page
Table (1): Components of production time for systems under study.....	48
Table (2): Relation between forward speed, actual productivity and efficiency for system ( $S_1$ )...	51
Table (3): Relation between forward speed, actual productivity and efficiency for system ( $S_2$ )...	53
Table (4): Relation between forward speed, actual productivity, and efficiency for system ( $S_3$ )...	55
Table (5): Relation between forward speed, actual productivity and efficiency for system ( $S_4$ )...	57
Table (6): Actual productivity for systems under study...	59
Table (7): Droplet distribution (No./cm <sup>2</sup> ) for knapsack hand sprayer for tree side spraying.....	61
Table (8): Droplet distribution (No./cm <sup>2</sup> ) for the tree side-spraying for knapsack air-carrier sprayer.....	63
Table (9) : Droplets distribution (No./cm <sup>2</sup> ) for stationary field sprayer from the tree side-spraying.	65
Table (10): Droplets distribution (No./cm <sup>2</sup> ) for mounted-boom field sprayer .....	69
Table (11): Covering efficiency for system under study...	72
Table (12) : Comparison of operation costs between the systems under study .....	74
Table (13): Operation costs for the systems.....	76
Table (13b): Relation between systems under study, cost L.E/ha and seasonal operation cost L.E.....	78
Table (14): Yield increase for systems under study .....	80
Table (15): Economical advantage criterion (K) for systems under study .....	82

## LIST OF FIGURES

	Page
Fig. (1): Knapsack hand operated sprayer.....	29
Fig. (2): View of the knapsack hand operator sprayer ...	30
Fig. (3): Knapsack air-carrier sprayer .....	32
Fig. (4): View of the knapsack air-carrier sprayer.....	33
Fig. (5): Stationary field sprayer.....	34
Fig. (6): Section view of the gun sprayer.....	35
Fig. (7): Mounted-boom field sprayer.....	36
Fig. (8): View of boom type-field sprayer .....	37
Fig. (9): System approach analysis.....	43
Fig. (10): Programme flow chart.....	46
Fig. (11): Operating time components .....	49
Fig. (12): Speed, product and field efficiency ( $S_1$ ).....	52
Fig. (13): Speed, product and field efficiency ( $S_2$ ).....	54
Fig. (14): Speed, product and field efficiency ( $S_3$ ).....	56
Fig. (15): Speed, product and field efficiency ( $S_4$ ).....	58
Fig. (16): Actual productivity for system under study ..	60
Fig. (17): Droplet No./cm <sup>2</sup> for system ( $S_1$ ).....	62
Fig. (18): Droplet No./cm <sup>2</sup> for system ( $S_2$ ).....	64
Fig. (19): Droplet No./cm <sup>2</sup> for system ( $S_3$ ).....	66
Fig. (20): Droplet No./cm <sup>2</sup> for system ( $S_4$ ).....	68
Fig. (20b): Relation between droplet No./cm <sup>2</sup> for tree side-spraying for systems under study .....	70
Fig. (21): Covering efficiency % for the different sprayers .....	73
Fig. (22): Comparison between the systems cost/h, cost/ha .....	75
Fig. (23): Seasonal operation cost L.E/ha for the spraying machinery .....	77

Fig. (23b): Relation between systems under study cost L.E/ha and seasonal operation cost L.E..	79
Fig. (24): Estimated increase of cotton yield related to systems under study .....	81
Fig. (25): Economical advantage criterion (K) .....	83