

Studies on machinery for low-volume application of agricultural chemicals

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This study was carried out to evaluate the technical and economical characteristics of four types of chemical applicators (Knapsack hand operator sprayer, knapsack air-carrier sprayer, stationary field sprayer, and mounted-boom field sprayer). All sprayers under study were tested and evaluated by making comparison between them to study the following points: 1- Field efficiency. 2- Actual productivity. 3- Covering efficiencies. 4- Operation costs. 5- Economical advantages criterion. The important results obtained from this study can be summarized as follows:

- 1- Field efficiency: It was found that the stationary field sprayer {S3} gave the highest field efficiency {60%}, comparing with the three systems of sprayers {knapsack hand sprayer, knapsack air-carrier, and mounted-boom field sprayer} {42, 41 and 16%}. The differences between them are due to the time losses of spraying.
- 2- Actual productivity: From the results, the mounted-boom field sprayer gave (5.92 ha/h) actual productivity comparing with the other systems (knapsack hand sprayer, knapsack air-carrier, and stationary field sprayer) (0.49, 0.68 and 1.31 ha/h), this is due to the differences between them in forward speeds, and width of sprayers.
- 3- Covering efficiency: The systems under study differed in covering efficiency due to the differences between their natures of the method of spray application. It was found that the knapsack air-carrier sprayer gave the best covering efficiency (78%) comparing with the other systems (knapsack hand sprayer, stationary field sprayer, and mounted-boom field sprayer) which gave 18%, 53% and 21% resp.
- 4- Operation costs: The highest cost/h per one operating hour (17 L.E/h) was recorded by mounted-boom field sprayer, mean while the same system gave the lowest operation cost/ha (2.93 L.E/ha), comparing with the knapsack hand-sprayer, knapsack air-carrier, and stationary field sprayer, which gave (2.065, 6.285 and 8.33 L.E/h and 4.21, 9.25 and 6.30 L.E/ha resp. These results are due to the increasing in actual productivity for system mounted-boom field-sprayer decreasing operation cost per ha.
- 5- Spray modeling program: From this study computer program can be made for spraying machine to select the optimum spraying machine under different operation condition via input required data in the program.
- 6- Economical advantage criterion: The knapsack air-carrier gave the highest economical advantage criterion (1357.72 L.E/ha) comparing with systems of knapsack hand sprayer, stationary field sprayer, and mounted-boom field sprayer, which gave (302.85, 922.18 and 357.98 L.E/ha) resp. The knapsack air-carrier recorded the highest economical advantage criterion L.E/ha, although it gave the highest seasonal cost (46.25 L.E/ha), but with the best covering efficiency (78%), which caused an increase in the final yield of cotton.

New contribution in this research: A computer program was devised to compare between different spraying machinery in different situations. The program has 3 main subroutines: (1) productivity factors, (2) operation cost factors, and (3) an economical-advantage criterion which combines the effects of cost and yield variations due to spraying, to guide selection of optimum spraying machinery for different situations.

RECOMMENDATIONS from this research the following can be recommended-

- The use of the knapsack air-carrier sprayer in cotton pest control. This is due to its high covering efficiency resulting from its application.
- Development of this sprayer for greater swath width, and for local manufacturing.
- Availing this type of sprayer for use in mechanization centers.
- Carrying on with more research on nozzle boom for mounted sprayers, and investigating the possibility of using air jets to aid in spray coverage. Care also should be given to perform other field operations in a way to

allow proper pest control mechanization (starting from soil preparation and ending with harvesting) .