NEW DEVELOPMENTS IN PESTICIDE APPLICATION-OPPORTUNITIES FOR SMALLHOLDER FARMERS IN UGANDA: WITH PARTICULAR EMPHASIS ON WOMEN

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ABSTRACT

The Controlled Droplet Application (CDA) of pesticides has been widely adopted over the last 30 years in many countries. However, its potentiality in overcoming major constraints in smallfarmer crop protection by removing the drudgery and need to fetch and carry large quantities of water to fields as required by conventional application techniques has not been realised in Uganda. This realisation came as a result of two years testing of the micron sprayer against the Electrodyne and the knapsack sprayers at Namulonge Agricultural and Animal Production Research Institute (NAARI). The rasults of the tests showed the following advantages of micron over the knapsack sprayers:
(i) Treatments can be made much more rapidly with less drudgery leaving time for the operators to do other productive work; (ii) spray volumes are minimal, only 5-15 litres of water per hactare as compared to 150-300L/ha with the knapsack; (iii) Savings of up to 40% can be realised from overall returns; (iv) Appropriate technology particulary for women farmers on basis of its high varsatility.

The paper presents research results with the sprayer and discusses its appropriateness to smallholder Integrated Pest Management (IPM) programmes particulary in Uganda where women contribute the bulk of farm labour and, peak spraying of cotton often coincides with water shortages.

Key words: Cotton, CDA, IPM, Women

INTRODUCTION

The policy of the Uganda Government is to diversify its exports and reduce the heavy dependence on coffee for its export revenues (Anon., 1993). In this regard, high priority has been given to increased agricultural enterprises in general, and intensified cotton cultivation in particular (Anon., 1991).

With increasing demands upon smallholder farmers to maximise cotton production, it is expected that pesticide usage in Uganda will increase markedly over the next few years. The cotton sub-sector Development Project (CSDP) aims at a significant increase in pesticide use on cotton from approximately 80,000 Litres/year presently to 300.000 liters by the year 2000 (Anon., 1993). The efficiency with which these large volumes of pesticides are going to be applied is therefore likely to be of major concern in the profitability of cotton production.

The CP 15 or 20 hand operated knapsack sprayer and its analogues have remained the major pesticide applicators where large volumes of water, usually 150 - 300 L/ha using hydraulic nozzles are required. While widely used by almost every farmer due to their ready availability and relative versatility, these sprayers are not necessarily appropriate in smallholder agriculture (Mathews, 1994), particularly where, in case of Uganda, women contribute the bulk of farm labor and in situations where pick spraying of cotton often coincides with dry spells and therefore water shortages. The necessity to fetch and carry large volumes of water from long distances is labor intensive and time consuming. The drudgery involved means that pesticide treatments if made at all, are often poorly applied and frequently ill-timed (Mathews, 1990; Clayton, 1992).

To overcome these constraints, techniques have been developed to apply pesticides in minimal spray volumes allowing treatments to be made much more rapidly and with less effort (King, 1976; Cauquil, 1987). Simple hand held spinning discs such as the Electrodyne (ED) and micron (ULVa+) sprayers which employ the principle of Controlled Droplet Application (CDA) have been developed for this purpose (Clayton, 1992). The objective of this study was therefore two fold: first to assess the efficiency of the two machines targeting the major insect pests of cotton and secondly to evaluate their impact on work rates of operators since this is directly related to the size of spray volume.

MATERIALS AND METHODS

To assess the efficiency of the micron and ED sprayers in comparison to the knapsack sprayer, experiments were conducted at Namulonge Agricultural and Animal production Research Institute (NAARI) during the 1992/93 and 1993/94 cotton seasons.

Field plots, 400m^2 (20 x 20 m) with 3 replications in 1992/93 and 324m^2 (18x18m) with 4 replications in 1993/94) were planted using cotton seed (Var. BPA 89) treated with cuprous oxide (Nordox). Two formulations of Lambdacyhalothrin (Karate) were used: Karate 2.5ED for the Electrodyne and Karate 2.0 EC for the ULVa+ and Knapsack sprayers.Initial trials applied the same active ingredients and dosage rates at 14 day intervals for the three sprayers. Spraying was done on a calendar basis with first spray at 35 days after seedling emergence and the three subsequent sprays at two week intervals. In all plots during this season, spraying was done row by row.

During the second season, the same insecticide spray regime was followed. For each sprayer, a plot was assigned in each of the four replications. The first plot in each case was sprayed using the row by row technique. In the second and third plots, spray passes were made on every 2nd and 3rd row respectively.

To assess the biological efficiency of the sprayers against insect pests, whole plant examination was done by sampling 30 plants per sub-plot and carefully examining the plants for presence of damage by lygus, bollworm larvae and aphids. Sampling was carried out at weekly intervals. Data was also collected on yield of seed cotton. A record was kept for the amount of water, chemical and time required to complete one sub plot using a team of 7 female operators (age range 15-35) and 11 male operators (age range 22-40). The comparative costs of using either sprayers were computed.

RESULTS AND DISCUSSIONS

Comparison between the micron, electrodyne and knapsack sprayers showed significant (P=0.05) differences in cotton pest control (Table 1a and 1b).

During the 1992/93 season, control of bollworms which were mainly *Helicoverpa amrigera* and *Erias* sp. was statistically higher (P=0.05) in the electrodyne and micron sprayed plots. Similar good pest control was recorded on plants infested with aphids (Table 1a). The electrodyne was most efficient among the test sprayers. No statistically significant differences in lygus damage and cotton bolls damaged by bollworms were obtained. This result seem to suggest that higher plant coverage was achieved using the electrodyne.

During the second season (1993/94) when spray passes were made at different row locations, statistically significant differences were observed among the three sprayers and also among the three row locations (Table 1b). Overall, the electrodyne and micron controlled lygus, bollworms and aphids significantly (P=0.05) better than the knapsack. The knapsack showed comparable efficiency against pests when spraying was done row by row. At 2 and 3 row spraying, the knapsack showed inferior performance against most of the target pests.

In general, no significant differences (P=0.05) were obtained when the micron and electrodyne were compared at different row locations (Table 1b). Results in respect to aphid control concurred with those of the previous year where both micron and electrodyne exhibited superior performance compared to the knapsack. The significant difference in aphid control when different row locations are considered probably demonstrates that there is insufficient plant coverage in droplet density which decreases as the number of rows increases. Consequently, a large residual population of aphids remain underneath the leaves. Control of the aphid was highly insufficient as nearly 66% (19/30) of the plants in the 3rd row position were infested after four sprays. This result reinforces the view raised by Sekamatte (1994), that improper usage of insecticides could be a factor influencing the current increase in incidence and pest status of *Aphis gossypii*.

Comparison of yield of seed cotton showed that spraying cotton with electrodyne was beneficial as yield increased by approximately 4% over the micron and 22% over the Knapsack (Table 2). A similar trend was obtained during the second season but with slightly lower yield differences. The lack of statistically significant differences among row locations (Table 1b) and yield production suggested that applying spray passes at every 3rd row was just as good as the row by row method and provides optimum protection to the crop. This result is of great significance as it determines the effectiveness of any spray program (Mathews, 1973). The reduced droplet density at higher row locations probably also presents a lesser risk to the pests natural enemies which may consequently have effect on residual pests populations. Studies on the cost implications of adopting the micron sprayer showed a significant out-lay of 46% compared to the knapsack (Table 3). Whether the micron, electrodyne or knapsack or any other spray practice are used will depend upon the preference of individual farmers and it is likely that it will be greatly influenced by the costs of treatment and availability of the technology. The costs of purchasing and maintaining spray equipment is in reality very small, around 5% (Gaudard, 1990) in comparison to the costs of chemicals hence it is this latter factor which will dictate which application method to be adopted. However, the time involved in undertaking spray treatments will also be an important factor for most of the small scale farmers (Pickin *et al.*, 1981) who in case of Uganda must save time for food crops production. Results of comparisons of spraying time (hours/ha) using different spray programs are shown in Table 4. Significant time savings are obtained while using the micron for both female and male operators. Results in this study however assume that the water for spraying is already at the field. This study did not take into account the time for fetching water from variable distances. Mathews (1973) reported spraying time per hectare of up 11 hours for a water collection distance of 1.0Km.

Conclusion

In view of the fast expansion of cotton production and pesticide usage in Uganda, the dependence on Knapsack sprayers need to be reviewed from both the biological and socioeconomic point of view. From the biological stand point, the same doses of active ingredient provide equivalent or even superior protection with the micron and electodyne. Significant differences in yield of seed cotton have been demonstrated. With regard to the effectiveness against insect pests, protection against the increasing infestation of cotton by aphids will require adoption of new spray technology in order to achieve cash out-lays on purchase of aphicides.

Socioeconomically, the adoption of the micron is likely to be a major factor in increasing the area protected due to the suitability of the sprayer to women operators who comprise a significant portion of farm labor in Uganda. Consequently, great improvements in yield of seed cotton and total production of cotton can be anticipated.

The acceptance of this technology however is likely to be complicated by the previous biological experimentation of old modelled ULV sprayers which apart from using large number of batteries (up to 12), were also restricted to oil based insecticides formulated for cotton only.

This micron technology may also face another disadvantage as has been the case in French West Africa that its ease of operation and elaborate versatility may lead to the slackening of parents participation in spraying activities and children asked to replace adults to apply treatments; this is highly un-desirable as pesticide hazards may become more serious than with the less efficient knapsack.

To reinforce efforts to develop the concepts of Integrated Pest Management (IPM), the efficiency of pesticide application must be critically reviewed. The advantage of removing the need to fetch and carry large quantities of water as required by the knapsack and its low weight allows greater participation of small scale women farmers in application of treatments. This added to the sprayers suitability to many other crop situations such as maize, vegetables, rice (Clayton, 1992)* makes the sprayer appropriate technology for the smallholder farmers of Uganda.

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Table 1. Comparison of Knapsack, Electrodyne and Micron spray treatments at NAARI. Incidence of insect pests and damage to cotton.

Table 1a. 1992/93 season

Type of sprayer	Lygus score per leaf	Bollworm larvae/30 plants	Bolls damaged 30 plants	Plants with aphids
Knapsack	0.92 + 0.1a	11.7+2.3a	9.11+0.7a	27.4 +5.6a
Electrodyne	0.48 + 0.1a	5.3+1.1b	6.3+2.0a	6.0 +0.2b
Micron	0.52 + 0.1a	5.7+0.9b	6.7+2.2a	19.3 +1.1a
L.S.D	n.s	3.68	n.s	9.9
C.V (%)	12.4	17.9	21.3	21.1

Table 1b. 1993/94 season

	No. rows	lygus score per leaf	Bollworm larvae/30 plants	Bolls damaged 30 plants	Plants with aphids
Knapsack	1	0.82a	3.4b	3.8	10.4b
	2	0.98b	6.9a	3.1	13.0b
	3	1.76a	6.3a	4.1	19.9a
Electrodyne	1	0.48b	2.8b	2.0	5.6c
	2	0.48b	2.7b	2.0	5.6c
	3	0.51b	3.7b	2.1	5.1c
Micron	1	0.22ab	2.9b	2.1	4.2c
	2	0.48b	3.1b	0.9	4.2c
	3	0.49b	2.5b	2.1	3.9c
L.S.D		0.21	2.7	n.s.	3.9

Table 2. Comparison of Knapsack, Electrodyne and Micron spray treatments at Namulonge; Yield of seed cotton Kg/ha.

	Sprayer Type								
	Knapsack			Electrodyne			Micron		
Rows	1	2	3	1	2	3	1	2	3
Season									
1992/93	975b	–	–	1,250a	–	–	1,195b	–	–
1993/94	865b	860b	705b	985a	1095a	955a	1,090a	1,090a	985a

Table 3. Comparative costs of knapsack, Electrodyne and Micron spray treatments at Namulonge using the row by row application technique

	Costs (UShs./ha)			
	1992/93		1993/94	
Item	Knapsack	Micron	Knapsack	Micron
Spray equipment	95,000	40,000	95,000	40,000
Batteries	0,00	1,500	0,00	1,800
Insecticides	12,900	12,900	12,900	12,900
Water*	3,000	150	3,000	100
Total costs	110,900	55,000	110,900	60,000
(% saving)		(46%)		(46%)

* Water costed at UShs. 200 per 20 Litre container
* The cost price for electodyne was not available

Table 4. Comparison of spraying time (hours/ha) of different spray programs 1993/94 season

	Spray technique	Mean spray time/ha F. operator (n=7)	M. operator (n=11)
Knapsack	1	4.15	3.05
Micron	1	2.05	1.55
Knapsack	2	2.25	2.00
Micron	2	1.05	0.55
Knapsack	3	1.50	1.15
Micron	3	1.10	1.05

F = Female operator; M = Male operator

Strategy: 1 = spray passes made on every row
2 = spray passes made on every 2nd row
3 = spray passes made on every 3rd row