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SHORT COMMUNICATION

EFFECT OF THE NOZZLE TYPE AND PRESSURE REGULATED SPRAYING ON THE WEED CONTROL EFFICIENCY OF PRE- AND POST- PLANT HERBICIDES

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INTRODUCTION

More than 90 % of rice farmers in Sri Lanka rely on pre- and post-plant herbicides for the management of weeds in the broadcasted rice crops. The application techniques, including the type of sprayers (power and knapsack sprayers), nozzles (single and double hollow cone nozzles, poly-jet nozzles, flat fan or deflective nozzles), dilution (amount herbicide per spray volume) and dose (amount herbicide per area) adopted in applying these herbicides vary among farmers in different areas (Abeysekara, 1999). This is in spite of the recommendations made by the Sri Lanka Department of Agriculture (DOA) for herbicide application that specify the use of flat-fan or deflector nozzle at 1.5 bar pressure at the rate of 400 – 450 L spray volume per ha (DOA, 2010). This paper highlights the importance of research information on the applicability, efficiency and effectiveness of the DOA recommendations compared to those practiced by farmers in view of saving pesticides, surface water used, and energy spent in spraying (Abeysekara *et al.*, 2001).

MATERIALS AND METHODS

This study focused mainly on two knapsack sprayers (KS), one with and the other without a pressure regulator (KS/PR and KS/WOPR) and three types of nozzles, the bronze-made single hollow cone nozzle, polypropylene deflective nozzle and flat fan nozzles (used only with the KSPR at 1.5 bar pressure). The experiments were conducted in the research fields at the Rice Research and Development Institute (RRDI), Batalagoda, Sri Lanka during the *yala* season in 2011 and 2012 and the spray volume per, pesticide used per, and the weed control efficacy of the treatments were assessed. Glyphosate 360 g L^{-1} SL (a pre-plant herbicide) and bispyribac-sodium 100 g L^{-1} SC (a post-plant herbicide) were used for the experiments, with an untreated control.

The two herbicides were sprayed separately at the recommended dilutions, *i.e.* glyphosate at 100 ml per 10 L and bispyribac-sodium at 7.5 ml per 10 L was sprayed separately to 54 m^2 plots demarcated in weed-infested paddy fields using a KS/PR fitted separately with a deflective and an even flat fan nozzles (at a constant pressure of 1.5 bar) and a KS/WOPR fitted with a hollow cone nozzle (without regulating the pressure). The weed control efficacy (WCE) was estimated at 14 days after treatment (DAT) using Equation 1 and expressed as % of the untreated control (Moody, 1983: Anderson, 1997).

$$WCE = \left[\frac{\text{Weed density in treated plots}}{\text{Weed density in untreated control}} \right] x\ 100 \quad \text{---------- Equation 1}$$

The amount of herbicides saved or used in excess for each treatment was calculated. The economic benefits of the spraying methods used were also estimated. The treatments were replicated three times in a randomized complete block design. The data obtained for two *yala* seasons in 2011 and 2012 were pooled for the analysis.

RESULTS AND DISCUSSION

The WCE of the spraying methods tested were not significantly different ($p>0.05$) for both herbicides indicating that these methods fulfill the farmer objectives (Table 1). However, the amount of herbicide used through the deflective nozzle was calculated to be 25 % less than the recommended dose. Thus, the saving of herbicide, man power (number of 16 L tanks ha^{-1}) and labor charges need to be considered in making a recommendation.

Table 1. Effect of Nozzle and sprayer type on weed control efficacy of glyphosate 360 g L^{-1} SL and bispyribac sodium 100 g L^{-1} SC (n=6); (*yala* season 2011 and 2012)

Treatment (Nozzle /Sprayer)	*Estimated Spray Volume (L ha^{-1})*	**Estimated Herbicide used (ml ha^{-1})*	*Herbicide saved (ml ha^{-1})*	*Weed control efficacy 14 DAT (% of control)*
Glyphosate				
Deflective - KS/PR	300	3,000	1,000	90
Flat Fan - KS/PR	400	4,000	-	95
Hollow cone – KS/WOPR	350	3,500	0,500	85
Bispyribac sodium				
Deflective - KS/PR	300	225	75	98
Flat Fan - KS/PR	400	300	-	96
Hollow cone – KS/WOPR	350	252	48	94

*Recommended dose for glyphosate (4,000 ml ha^{-1}) and for bispyribac sodium (300 ml ha^{-1})

The estimated time for spraying was 20 min per spray tank, and the average labor charge for spraying was Rs 100 tank^{-1}. Hence, the use of deflective nozzle with a KS/PR helped save 140 min ha^{-1} for spraying and Rs 700 ha^{-1} from labor charges (Table 2). This spraying technique (use of deflective nozzle with a 1.5 bar constant pressure) saved 1,000 ml glyphosate 360 g L^{-1} SC ha^{-1} as compared to the recommended application rate (4,000 ml ha^{-1}; Table 1). This application technique also helped follow the label recommended dose (300 ml ha^{-1}) of bispyribac sodium 100 g L^{-1} SC as compared to the volume required for spraying with a flat fan and hollow cone nozzles.

Table 2. Comparison of the economic benefit of tested three nozzle types for pre- and post-plant weed control using glyphosate 360 g L^{-1} SL and bispyribac sodium 100 g L^{-1} SC

Treatment (Nozzle/sprayer)	*Spray volume required (L ha^{-1})*	**Spray volume saved (L ha^{-1})*	*16 L tanks saved*	*Time saving (min ha^{-1})*	*Labor cost saving (Rs ha^{-1})*	*Ground water saving (L ha^{-1})*
Deflective - KS/PR	300	100	7	140	700	112
Flat Fan - KS/PR	400	0				
Hollow cone - KS/WOPR	350	50	3	60	300	48
**Recommended	400-450	-	-	-	-	

*compared to the lowest recommended spray volume of 400 L ha^{-1}; ** spray volume recommended for the application of rice herbicides (L ha^{-1})

CONCLUSIONS

Application of glyphosate 360 g L^{-1} and bispyribac-sodium 100 g L^{-1} SC using a deflective nozzle at 1.5 bar constant pressure required a dose of 3 L ha^{-1} (recommendation 4,000 ml ha^{-1}) and 300 ml ha^{-1} (recommendation 300 ml ha^{-1}) respectively. This application technique helped save spraying time (by 140 min ha^{-1}) and about 100 L ha^{-1} surface water used for mixing while providing equally effective weed control as obtained with flat fan and hollow cone nozzles. This method was economical and environmentally friendly compared to spraying of herbicides using a hollow cone nozzle.

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