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WEED CONTROL PRACTICES IN IRRIGATED AND RAINFED RICE FARMS IN NUEVA ECIJA, PHILIPPINES

by

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WEED CONTROL PRACTICES IN IRRIGATED AND RAINFED RICE FARMS IN NUEVA ECIJA, PHILIPPINES

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A survey comparing farmer weed control practices in irrigated and rainfed rice (*Oryza sativa* L.) fields in Nueva Ecija, gave the following highlights:

a) Variation was observed between the two areas in the weeds that the farmers regard as the most important.

b) In the irrigated area most of the farmers applied herbicides for weed control while in the rainfed area most of the farmers hand weeded their crop.

c) In the irrigated area most of the farmers who applied herbicide used liquid butachlor (N-butoxymethyl-o-chloro-2',6'-diethylacetanilide). In the rainfed area most applied liquid 2,4-D (2,4-dichlorophenoxy acetic acid).

d) Herbicide prices varied within and between areas. Granular herbicides were less expensive per unit of active ingredient than the liquid herbicides.

e) Farmers applied greater rates of the granular herbicide formulations than those of the liquid formulations.

INTRODUCTION

Recent changes in rice production technology, most notably the widespread adoption of modern cultivars, have dramatically modified the pest control problems confronting the farmers. Before the introduction of the modern cultivars, farmers used manual methods of weed control or did not weed their crops. Traditional rice culture is characterized by low material input, low productivity, low profitability, and a high level of field stability.

Several studies have shown that modern cultivars need more crop care than traditional cultivars. In Manaoag, Pangasinan Province, 78% of the farmers reported that they weeded modern cultivars more than they did traditional cultivars (Navarez and Moody, 1979).

The rapid adoption of modern cultivars in irrigated areas in the Philippines has been accompanied by a marked increase in the amount of fertilizer applied (Smith and Gascon, 1979; Huke et al., 1980; Cordova et al., 1981). Cordova et al. (1981) noted that even in the rainfed or poorly irrigated areas, most of the farmers grew modern cultivars. The early-maturing modern cultivars minimized the risk of drought damage, especially in the poorly irrigated areas.

Farmers in rainfed transplanted rice areas in the Philippines recognize that weeds compete with their crops and cause yield reductions (Navarez and Moody, 1979; Estorninos et al., 1982) while those in the irrigated areas of Laguna Province recognize the importance of timely weeding (Smith and Gascon, 1979).

The major weeds growing in association with rainfed transplanted rice vary in different regions of the Philippines because of factors such as the environment and cultural practices (Estorninos et al., 1982). In Manaoag, Pangasinan Province, farmers regard *Monochoria vaginalis* (Burm.f.) Presl, *Cyperus difformis* L., *Fimbristylis miliacea* (L.) Vahl, *Commelina diffusa* Burm.f., *Echinochloa colona* (L.) Link, and *Cynodon dactylon* (L.) Pers. as the most important weeds (Navarez and Moody, 1979). In Iloilo Province, *Ischaemum rugosum* Salisb., *F. miliacea*, and *C. dactylon* were reported to be the most important weeds while in the Cagayan Valley, *M. vaginalis*, *F. miliacea*, *C. difformis*, *Ipomoea aquatica* Forsk., *Echinochloa stagnina* (Retz.) Beauv., *E. colona*, and *C. dactylon* were dominant (Estorninos et al., 1982).

Farmer's adoption of the modern cultivars has also led to changes in weed control practices. Observing the changes in weeding practices in Central Luzon between 1966 and 1979, Cordova et al. (1981) noted that in Central Luzon, 64% of the farmers surveyed used hand weeding in 1966 while 28% did no weeding, and 8% applied herbicides. By 1979, 35% of the farmers used hand weeding, 56% used herbicides or a combination of herbicides and hand weeding to control weeds. Only 9% of the farmers did no weeding. In 1966, an average of one application of herbicide was made between 21 and 30 days after transplanting (DAT). By 1979 some farmers were making as many as three herbicide applications (1-10, 31-40, and 51-60 DAT) and one hand weeding. Expenditures on herbicides increased continuously from ₱1 to ₱32 over the said period, with the total amount spent on weeding having increased from ₱18 to ₱102.

This study reports the results of surveys dealing with weeds and their control in rainfed and irrigated rice farms in Nueva Ecija, Philippines, as part of a study on the consequences of small rice-farm mechanization in Asia.

MATERIALS AND METHODS

One hundred and fifty farmers were interviewed in September 1979; 75 of them were randomly selected from barrios Bagong Sikat and Bakero in an

irrigated area in Cabanatuan City and the other 75 from barrios Manggang Marikit, Pasong Inchik, and San Rafael in the rainfed area in Guimba.

The factors evaluated in the survey are shown in Figures 1 and 2. Interview data are in boxes with broken lines. The reference parcel for each farm was that plot which had been most recently harvested or was about to be harvested. The reference cropping seasons in the irrigated areas were the 1978 dry season and the 1979 wet season crops. In the rainfed areas the reference cropping seasons were the 1978 and 1979 wet seasons.

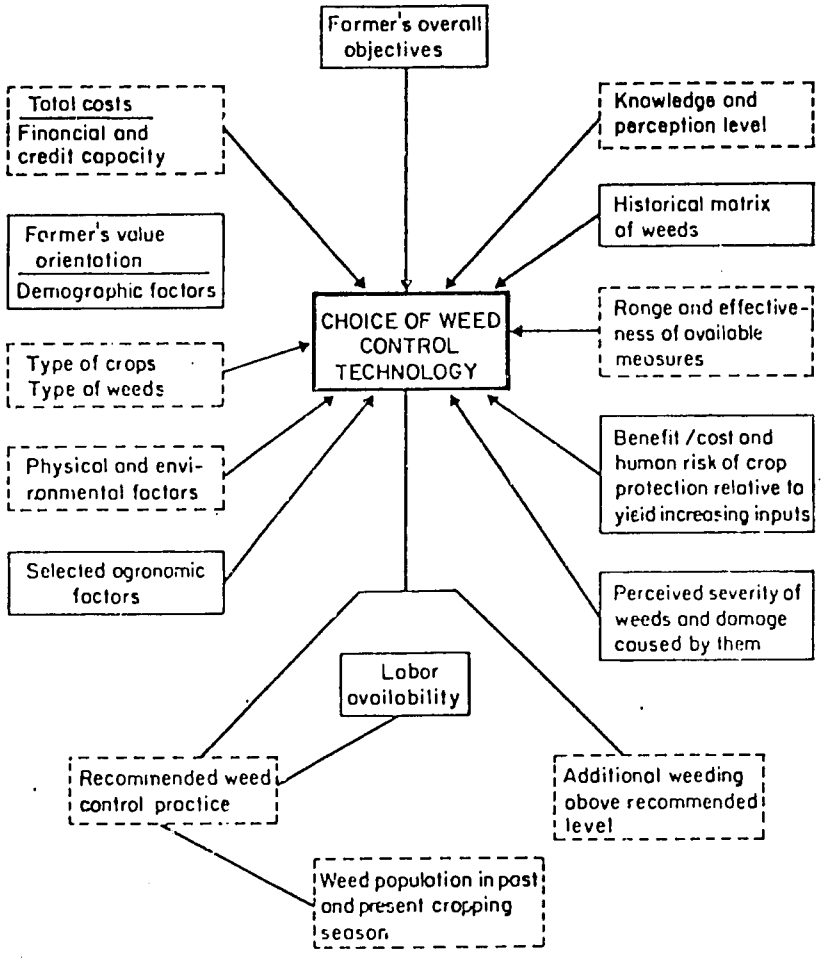

Fig. 1. Factors involved in the choice of a suitable weed control technology.

Farm Situation

Farms in Bakero and Bagong Sikat were fully irrigated. Water supply was sufficient for both the wet and dry seasons so that farmers are able to plant two crops per year. Average farm size was 2.2 ha and the average size of a reference parcel was 1.8 ha. Thirty-six farmers had two or more parcels. The average yield from harvested parcels was 4 t/ha (Table 1).

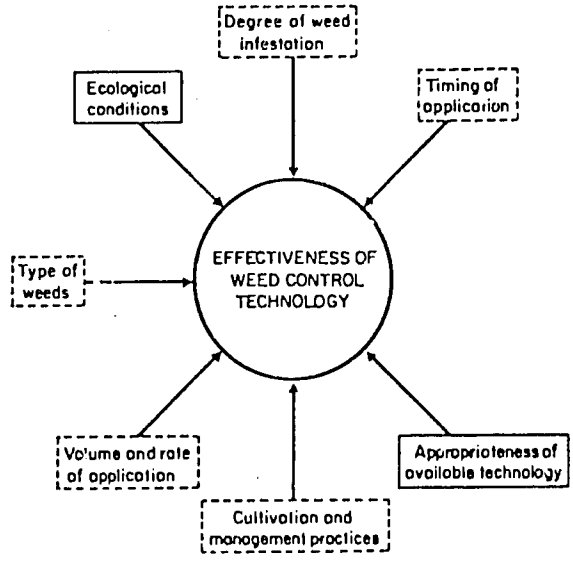

Fig. 2. Factors influencing effectiveness of weed control technology.

Table 1. Farm size and yield per hectare of 150 irrigated and rainfed farms in Nueva Ecija, 1979.

Type of Farm	Average Farm Size (ha)	Average Size of Reference Parcel (ha)	Yield from Reference Parcel (t/ha)	
			Expected[a]	Harvested
Irrigated	2.2	1.8	4	4
Rainfed	1.8	1.2	2	3

[a]Fields yet to be harvested.

Farms in Manggang Marikit, Pasong Inchik, and San Rafael were rainfed. A few farmers had pumps but almost all units were inoperable. Average farm size was 1.8 ha and the reference parcel was 1.2 ha. Forty-four farmers had two or more parcels. Average expected and harvested yields were 2 and 3 t/ha, respectively.

Eighty-five percent of the irrigated and 81% of the rainfed areas were operated on a leasehold basis (Table 2).

RESULTS AND DISCUSSION

Most farmers in both irrigated and rainfed areas planted IR36 although IR34, IR40, IR46, IR22, and IR44 were also grown; five farmers in the rainfed area did not know the name of the cultivar they were growing (Table 3). Farmers in irrigated areas planted only rice. Some farmers in rainfed areas planted vegetables on a part of the area following the wet season rice harvest.

Table 2. Average farm size by tenure status of 150 irrigated and rainfed farms in Nueva Ecija, 1979.

Tenure Status	No. Reporting	Average Size (ha)
Irrigated		1.8
Leased	64	1.7
Owned	7	1.7
Mortgaged	4	2.6
Rainfed		1.2
Leased	61	1.2
Owned	6	1.4
Mortgaged	3	0.8
Share-cropped	3	0.8
Amortized	2	1.6

Table 3. Rice cultivar planted in irrigated and rainfed farms in Nueva Ecija, 1979. Figures in parentheses are percentages of total number reporting.

Cultivar	Number Reporting	
	Irrigated	Rainfed
IR36	64(85.3)	54(79.4)
Maligaya	3(4.0)	4(5.9)
IR42	2(2.7)	2(2.9)
IR46	2(2.7)	—
IR44	2(2.7)	—
IR34	1(1.3)	1(1.5)
IR22	1(1.3)	—
Unknown	—	5(7.4)
IR28	—	2(2.9)

Differences in the weed species that farmers regarded as important was observed between the irrigated and the rainfed areas (Table 4). In the irrigated area, the weeds that were regarded as the most important were *Echinochloa crus-galli* (L.) Beauv., *Paspalum distichum* L., and *M. vaginalis.* In the rainfed area, the most important weeds were reported to be *I. rugosum, F. miliacea, E. crus-galli,* and *M. vaginalis.*

Nine and 13 species were identified as important in the irrigated and the rainfed areas, respectively. Seven species were common to both areas. Except for *E. crus-galli* and *M. vaginalis,* there appears to be little similarity in the weed flora between the two areas. While *E. colona, Brachiaria mutica* (Forsk.) Stapf., and *Panicum repens* L., were regarded as important by some farmers in the rainfed area, they were not regarded as important in the irrigated area. On the other hand, *Ceratophyllum demersum* L. and *Eichhornia crassipes* (Mart.) Solms, which were reportedly important in the irrigated areas, were not regarded as such in the rainfed area.

Table 4. Problem weeds as identified by farmers in irrigated and rainfed areas in Nueva Ecija, 1979. Totals add up to more than the number of farmers interviewed because most farmers regarded more than one weed as being a problem.

Weed Species	Irrigated	Rainfed
Echinochloa crus-galli	61	19
Paspalum distichum	18	4
Monochoria vaginalis	12	14
Sphenoclea zeylanica	2	1
Fimbristylis miliacea	4	27
Ceratophyllum demersum	1	—
Ischaemum rugosum	2	30
Eichhornia crassipes	1	—
Cyperus rotundus	—	2
Ipomoea aquatica	1	5
Echinochloa colona	—	2
Panicum repens	—	5
Brachiaria mutica	—	2
Leersia hexandra	—	1
Cyperus sp.	—	1

About 60% of the farmer respondents said that weed problems had not increased since 1968 when the modern cultivars were introduced (Table 5). The number of farmers who perceived weeds to be more of a problem since the introduction of the modern cultivars was greater in the irrigated area than in the rainfed area.

Table 5. Effect of the introduction of modern cultivars on weed problems in Nueva Ecija, 1979. Figures in parentheses are percentages of total number reporting. Totals add up to less than the number of farmers interviewed because not all responded to this question.

Problem	Number Reporting	
	Irrigated Farms	Rainfed Farms
Same as before	42(57.5)	29(69.0)
Problem has increased	29(39.7)	13(31.0)
Can't recall	2(2.8)	—
Total	73	42

The weed control methods used by the farmers varied between the two areas (Figure 3). The majority (82.7%) of the farmers in the irrigated area used herbicide alone or a combination of herbicide and hand or rotary weeding. Only 2.7% said that they did no weeding. In contrast, only 20% of the rainfed farmers used chemical weed control methods or a combination of

chemical weed control plus hand weeding; 64% said that they hand weeded while 16% did no weeding. Rotary weeding is rarely used because the majority (91% in the irrigated area; 97% in the rainfed area) of the farmers used random transplanting. Thus, under poorer water conditions when herbicide performance is likely to be reduced and yield levels are lower, the tendency to use herbicides was less. The farmers appear to have adjusted their weed control intensity to the production potential of the crop under a given set of environmental conditions.

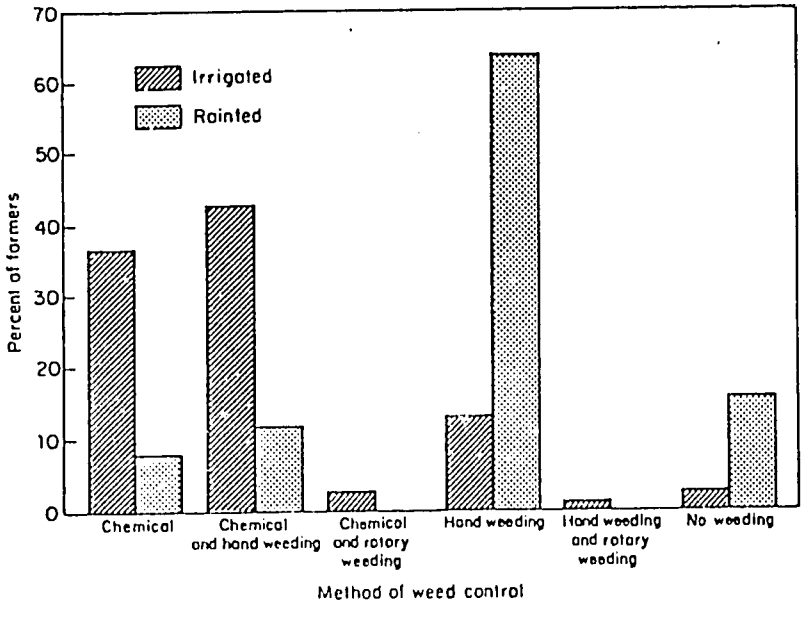

Fig. 3. Frequency distribution by method of weed control, 150 farmers, Nueva Ecija, 1979.

Some farmers reported that they started using herbicides as early as 1950. Herbicide use, particularly in the irrigated area, has increased greatly since the introduction of the modern cultivars. The adoption of herbicides has been slower in the rainfed area (Figure 4) than in the irrigated area (Figure 5) as has been the adoption of modern cultivars, sprayer usage, and insecticides.

Seventy-seven percent of the irrigated farmers obtained information on herbicides from extension agents. In the rainfed area, extension agents (32%) and other farmers (58%) were the commonest sources of information. Extension agents usually recommended herbicides of a particular company. Experienced farmers recommended those herbicides which they found to be effective. Government agricultural and credit programs have promoted extensively the use of chemical weed control as the best means of weed control by tying agricultural credit to both herbicides and cash or herbicides alone.

In the irrigated area, most of the farmers applied liquid butachlor while in the rainfed area most of those who applied herbicide used liquid 2,4-D (Table 6).

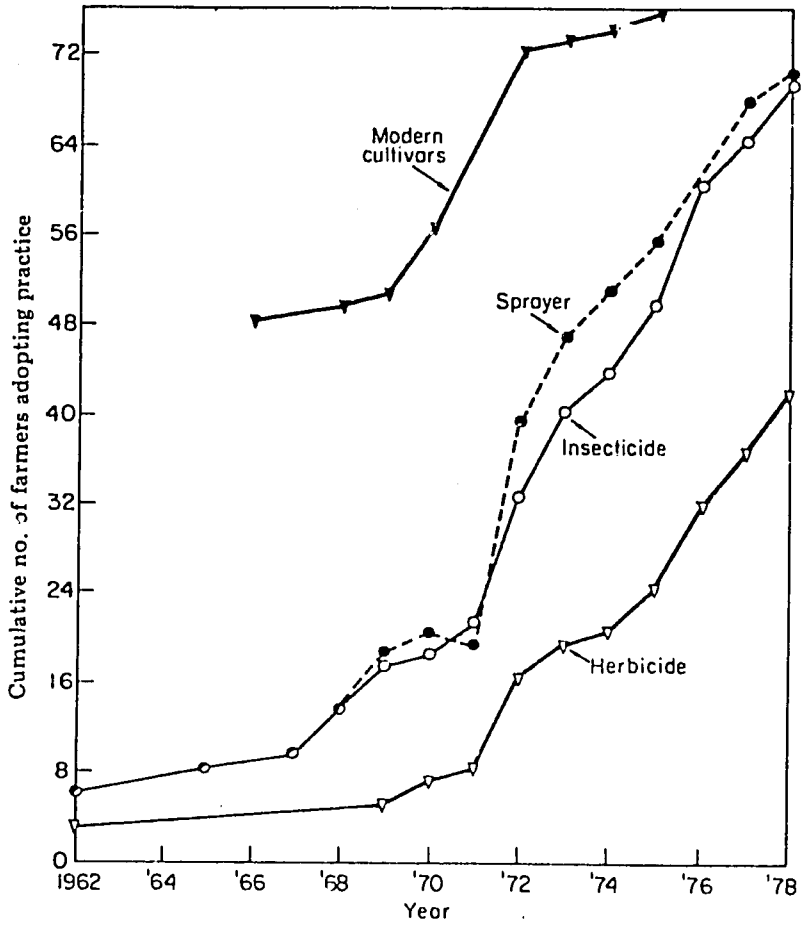

Fig. 4. Adoption of modern cultivars and weed control technology, rainfed farmers, Nueva Ecija, 1979.

The majority of the farmers applied herbicides at less than the recommended rate (Table 6) as has been observed previously by Navarez and Moody (1979), Estorninos et al. (1982), and Mercado (1980) for other parts of the Philippines. In the irrigated area, only one farmer applied butachlor liquid at the recommended rate of 1.0 kg/ha. Eight farmers underdosed by a factor of one to two while 35 farmers underdosed by a factor of four to nine. It is doubtful if any weed control was achieved with the lowest rates used. Only one farmer applied granular butachlor at the recommended rate while the rest of the farmers underdosed by a factor of 4 to 7. 2,4-D liquid was applied by three farmers at an average of 69% less than the recommended rate of 0.8 kg/ha. 2,4-D granular was applied at higher rates but the farmers who used this herbicide underdosed by 15%.

In the rainfed area, farmers applied approximately the same amount of butachlor (both liquid and granular) as in the irrigated area but rates of 2,4-D application, particularly the granular formulation, were lower.

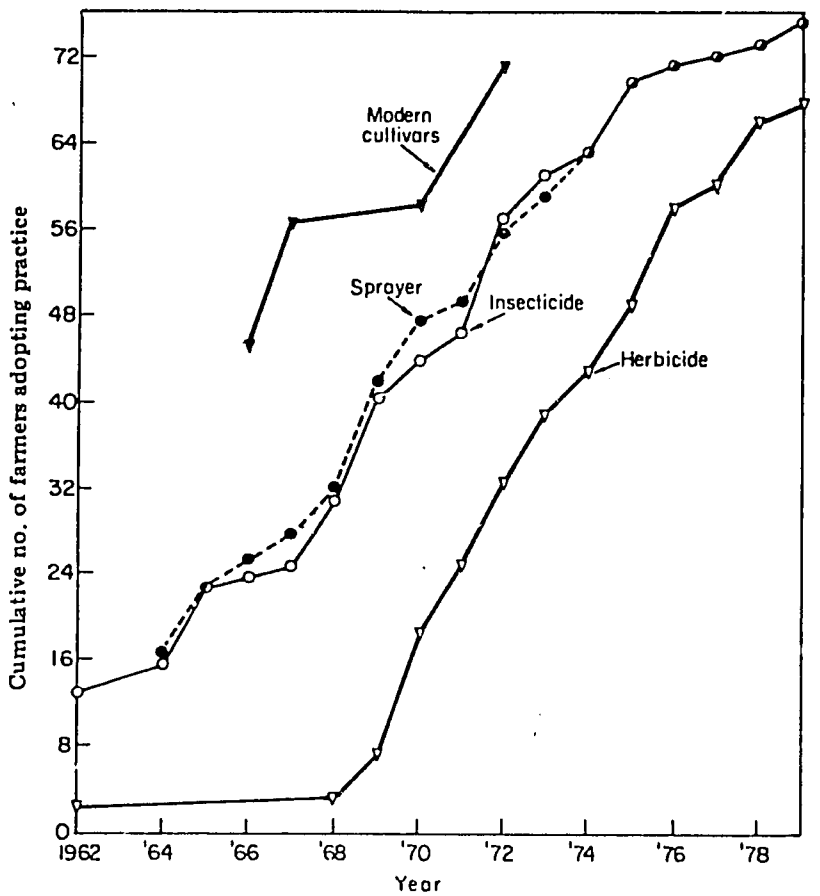

Fig. 5. Adoption of modern cultivars and weed control technology, irrigated farmers, Nueva Ecija, 1979.

In both areas and for both butachlor and 2-4-D, farmers applied greater rates of the granular formulations than the liquid formulations. This may be related to the ease of applying the granular formulation and the problems with calibration when a liquid formulation is used .

Only a few farmers hired labor for weeding. The average labor cost was ₱5 to ₱6 per man-day without a meal and ₱4 with a meal provided. One farmer hired school children at ₱0.50 for 4 hours' work.

The price that farmers paid for herbicides varied within and between areas (Table 7) as has been reported for other areas of the Philippines by Moody et al. (1980). On a per-unit basis (₱/g a.i.) granular butachlor cost about the same as butachlor liquid while 2,4-D granular was cheaper than 2,4-D liquid. The farmers, however, are not aware of this. To them the reality of the market price of herbicides is in terms of the money they have to part with or, if they obtained credit, it is the purchase price per liter or kilogram. To overcome this problem, Moody et al. (1980) recommended unit pricing or giving the price to treat a standard area at a standard rate.

Table 6. Rate of herbicide application, 75 farms, Nueva Ecija, 1979.

Herbicide and No. of Farmers Using Treatment	Herbicide Rate (kg a.i./ha)[1]	
	Irrigated	Rainfed
Butachlor (liquid)		
Range	0.08 — 1.2	0.12 — 0.48
Average	0.44	0.4
Number reporting	44	4
Butachlor (granule)		
Range	0.12 — 1.04	0.53 — 0.8
Average	0.61	0.65
Number reporting	10	3
2,4-D (liquid)		
Range	0.25 — 0.28	0.06 — 0.64
Average	0.25	0.21
Number reporting	3	10
2,4-D (granule)		
Range	0.23 — 1.07	0.36 — 0.54
Average	0.68	0.52
Number reporting	6	4
MCPA		
Range	—	—
Average	0.34	—
Number reporting	1	—
Thiobencarb-2,4-D		
Range	0.42 — 1.88	—
Average	1.04	—
Number reporting	3	—

[1] a.i. = active ingredient. Recommended rates: 2,4-D, 0.8 kg a.i./ha; butachlor, 1.0 kg a.i./ha; MCPA, 0.8 kg a.i./ha; thiobencarb-2,4-D, 1.2 kg a.i./ha.

The unit price of butachlor was lower or about the same as that of 2,4-D. Even if these herbicides are applied at the recommended rate of 1.0 kg a.i./ha for butachlor and 0.8 kg a.i./ha for 2,4-D, butachlor application would frequently be cheaper. Also, granular herbicides were less expensive per unit of active ingredient than liquid herbicides. The farmers' decision as to which herbicide to buy is determined by the price of the packaged product.

The economic and physical conditions under which the farmers operated probably influenced their choice of herbicides. Most farmers in the irrigated areas used liquid butachlor and the rainfed farmer commonly used liquid 2,4-D. Farmers in the rainfed area are aware that insufficiency of water lowers the economic productivity of rice. Hence the farmers who used herbicides chose 2,4-D, whose packaged product had a lower purchase price.

Table 7. Purchase price and unit price of herbicides in Nueva Ecija, 1979.

Herbicide	Volume	Irrigated		Rainfed	
		Purchase Price (₱)	Unit Price[a] (₱)	Purchase Price (₱)	Unit Price[a] (₱)
Butachlor (liquid)	473 ml				
Range		21.50-27.00	.076-.095	25.00-26.00	.088-.092
Average		24.25	.085	25.50	.090
	946 ml				
Range		40.00-60.50	.070-.107	43.00-44.00	.076-.078
Average		50.85	.090	43.50	.077
Butachlor (granule)	25 kg				
Range		92.00-105.00	.074-.084	105.00	.084
Average		96.30	.077	—	—
2,4-D (liquid)	236 ml				
Range		12.60	.133	12.00-12.50	.127-.132
Average		—	—	12.25	.130
2,4-D (liquid)	473 ml				
Range		25.00	.132	24.40-27.00	.129-.143
Average		—	—	25.47	.135
2,4-D (granule)	25 kg				
Range		50.00-84.00	.063-.105	50.60-70.00	.063-.088
Average		67.00	.084	60.20	.075
MCPA	473 ml				
Range		16.50	.087	—	—
Average		—	—	—	—
Thiobencarb-2,4-D	25 kg				
Range		92.00-105.00	.074-.084	—	—
Average		98.50	.074		

[a]Per gram active ingredient or acid equivalent.

Farmers' Preferred Method of Weed Control

The farmer's perception of the sociocultural and economic conditions surrounding his rice enterprise helps explain the weed control technique that he is now using and indicates the type of weed control he may ultimately adopt. His preferred method of weed control may differ from that which he is actually using.

Given adequate cash resources, 85% of the irrigated farmers said that they would prefer to use herbicides for weed control. This is a slight increase over the 83% now using herbicides (Figure 3). In the rainfed area, 63% of the farmers said that their preferred method of weed control was herbicides. This is a substantial increase over the 20% that are now using this technique.

The rest of the farmers in the irrigated area said that their preferred method was manual weeding. In the rainfed area, 37% preferred hand weeding while 10% were undecided.

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