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EVALUATION OF HERBICIDE MIXTURES FOR WEED CONTROL IN TRANSPLANTED RICE-PULSE CROPPING SYSTEM*

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Field experiments conducted in rice with EPTC and molinate either alone or in combination with 2 4-D ethyl ester (EE) or propanil revealed that the combination of herbicides was more effective in improving the spectrum of weed control. Application of 2, 4-D EE against sedges, propanil against dicots and molinate or EPTC against grasses was found effective. Thiobencarb and molinate + 2, 4-D EE gave season long weed control resulting in reduced weed density in succeeding greengram.

The undependable supply of relatively cheap labour in many cases has given impetus to the development and use of chemicals for weed control. With the introduction for commercial usage of propanil, a contact herbicide in the year 1961 and molinate in 1965, a thiocarbamate herbicide with residual activity the chemical control of barnyard grass became possible (Oelke and Morse, 1968). Selective control of barnyard grass with EPTC was also reported (Forster, 1964). However, studies on mixtures of these herbicides with propanil and 2, 4-D ethyl ester (EE) are limited. Mixtures of compounds are now increasingly being employed for cost effective control of broader spectrum of weed species. Hence investigations were carried out to evaluate the efficacy of molinate and EPTC singly and mixed with 2, 4-D EE or propanil in transplanted rice and their residual effect on succeeding greengram.

MATERIALS AND METHODS

Field experiments were conducted at Tamil Nadu Agricultural University in kharif 1985 and summer, 1986 to evaluate the performance of molinate, EPTC and their mixtures with 2, 4-D EE or propanil. The herbicide doses for the second crop (Summer 1986) were modified based on the results of first crop. The treatmen details are given in tables 1 and 2. The experiments were laid out in randomised complete block design with four replications. The test variety was IR. 50. Recommended agronomic and plant protection measures were adopted except weed control. After harvest of the summer crop greengram seeds were dibbled in rice stubbles and irrigated.

In rice observations on weed population and weed dry matter were recorded at 60 days after transplanting and in greengram at 20 days after sowing. Because of heavy in-

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festataion of weeds it was decided to give one hand hoeing and weeding to all the treatments in the greengram crop.

RESULTS AND DISCUSSION

Weed flora

The weed flora of the experimental field consisted *Echinochloa crusgalli* (L.) Beauv and *E. colona* (L.) Link in grasses; *Cyperus iria* (L) and *C. difformis* in sedges; *Eclipta alba* and *Ammania baccifera* in broad leaved weeds and *Marsilea quadrifoliata* L. and *Monochoria vaginalis* L. in aquatics.

Grass weeds were dominant (55-60%) in both kharif and summer seasons. The next in order was sedges in *kharif* while it was dicots and aquatics in summer.

RICE : Kharif 1985.

EEFECT ON WEEDS :

At 60 days after transplanting (DAT) the lowest grass weed density was observed in hand weeding twice with the relative density at 24.8 percent. All the herbicide treatments effectively controlled grasses with relative densities ranging from 30.1 to 34.6 percent while it was 58.8 percent for unweeded check. The herbicide treatments except molinate at 1.88 kg ai/ha failed to control sedges. Molinate and EPTC applied alone failed to control dicot weeds effectively compared to their combinations with propanil or 2, 4-D EE. Of all the herbicide treatments the total weed control efficiency of thiobencarb was comparable with hand weeding twice indicating its season long residual action on late germinating weeds (Dusky, 1984). A similar trend on weed dry matter was observed.

EFFECT ON CROP

None of the herbicides tested caused phytotoxicity to rice. Highest grain yield was obtained with hand weeding twice (6099 kg/ha). This was followed by thiobencarb (Table 1). However, all the herbicide treatments were significantly superior to unweeded check. This might be due to effective control of weeds by herbicides on early stage of crop growth up to 40 DAT.

The economics of weed control revealed that thiobencarb at 1.50 kg/ha was cost effective with a marginally high return of 0:08 rupee over EPTC + 2, 4-D EE.

Based on these results, herbicide doses were modified for the summer crop to improve the efficacy and to widen the spectrum of weed control (Table 2).

SUMMER 1986

EFEECT ON WEEDS

Thiobencarb at 1.5 kg ai/ha effectively controlled the grass weeds resulting in relative density of 27.4 percent followed by EPTC. The selective control of grasses, particularly barnyard grass in rice by soil

Table 1. Effect of treatments on weed population and drymatter (60 DAT and grain yield of rice in kharif 1985)

Treatments	Dose kg/ha	Time of application	Weed population no/m²			Total weed control efficiency	Weed dry matter g/m²	Grain yield kg/ha	Net return per rupee invested (Rs.)
			Grass	Sedge	Dicots				
Molinate	1.80	Pre. em.	17.0 de (1.28)	45.0 ab (1.23)	20.0 d (1.34)	66.7	15.65 b	5466 bc	1.32
Molinate+2,4 – D EE	0.90+ 0.56	Pre. em.	16.7 ac (1.21)	18.6 c (1.31)	16.5 c (1.27)	66.7	17.45 b	5380 bc	1.31
Molinate + propanil	0.90 0.90	Early post em.	18.0 e (1.30)	17.5 c (1.29)	17.2 c (1.28)	66.2	17.07 b	5038 c	1.14
EPTC	1.98	Pre. em	15.5 cd (1.24)	16.3 bc (1.26)	19.7 d (1.34)	66.9	16.63 b	5369 bc	1.34
EPTC+2 4 - D EE	1.12+ 0.56	Pre. em.	15.0 c (1.23)	15.0 ab (1.23)	15.2 c (1.24)	70.1	14.68 b	5830 b	1.52
EPTC+Propanil	0.90 0.90	Early Post em	18.5 e (1.31)	17.5 c (1.29)	17.5 cd (1.29)	65.5	17.51 b	5105 c	1.23
Thiobencarb	1.50	Pre em.	12.7 b (1.16)	14.0 a (1.20)	13.0 b (1.18)	74.3	12.07 ab	6032 a	1.60
Handweeding twice	–	–	8.2 a (1.01)	14.4 ab (1.22)	10.5 a (1.09)	78.0	8.98 a	6099 a	1.47
Unweeded check	–	–	91.5 f (1.97)	40.2 d (1.63)	23.8 e (1.41)	0.0	34.52 c	3734 d	0.73

In a column any two means followed by anyone common letter are not significantly different from each other by DMRT.

( ) = (LOG (X+R)) TRANSFORMATION

Table 1. Effect of treatments on weed population and drymatter (60 DAT and grain yield of rice in summer 1986)

Treatments	Dose kg/ha	Time of application	Weed population no/m²			Total weed control efficiency	Weed dry matter g/m²	Grain yield kg/ha	Net return per rupee invested (Rs.)
			Grass	Sedge	Dicots				
Molinate	2.88	Pre. em.	14.2 bc (1.21)	13.5 ab (1.17)	11.5 a (1.02)	85.5	18.26 ab	6074 ab	1.45
Molinate + 2,4-D EE	1.80 + 0.56	Pre. em.	9.5 ab (1.05)	9.5 a (1.05)	9.7 a (1.06)	88.4	15.40 a	6180 a	1.54
Molinate + propanil	1.44 + 1.44	Early post em.	15.5 cd (1.24)	11.5 bc (1.22)	13.2 ab (1.18)	83.8	19.02 ab	5917 ab	1.39
EPTC	2.88	Pre. em	23.2 de (1.39)	22.0 cd (1.37)	30.3 c (1.50)	69.5	25.07 b	5600 ab	1.38
EPTC + 2, 4 – D EE	1.12 + 0.56	Pre. em.	14.7 bcd (1.22)	9.5 a (1.05)	19.3 bc (1.33)	78.2	21.08 ab	5834 ab	1.53
EPTC + Propanil	1.44 + 1.44	Early Post em	43.1 e (1.63)	26.0 d (1.41)	21.5 bc (1.32)	68.2	35.38 c	5519 b	1.33
Thiobencarb	1.50	Pre. em.	8.0 a (1.00)	10.2 ab (1.08)	11.0 a (1.11)	88.2	18.40 ab	6119 ab	1.64
Handweeding twice	–	–	8.5 a (0.99)	9.5 a (1.04)	9.0 a (1.02)	89.1	15.02 a	6229 a	1.52
Unweeded check	–	–	148.5 f (2.13)	49.5 e (1.71)	49.5 d (1.71)	0.0	95.33 d	3130 d	0.45

In a column any two means followed by anyone common letter are not significantly different from each other by DMRT.

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applied thiobencarb was due to decrease in adventitous roots and leaf dieback (Rao, 1983). EPTC caused kinking of the first internode. The emerging leaves did not unfurl but stayed within coleoptile which was the major site of EPTC injury. Growth beyond coleoptile ceased (Dawson, 1933).

However, both the herbicides failed to control dicots. Among all the herbicide treatments, molinate + 2, 4-D EE at 1.80 + 0.56 kg/ha resulted in broader spectrum of weed control with 33.1, 33.1 and 33.8 percent relative densities for grasses, sedges and dicots, respectively. Broader spectrum of weed control through molinate + 2, 4 D EE was also reported by Ali and Sankaran (1985). EPTC + 2, 4-D EE mixture was effective against sedges. Mixtures with propanil resulted in effective control of dicots. The lowest weed dry matter was recorded in hand weeding twice which was comparable with molinate + 2, 4-D EE followed by thiobencarb with the reduction in weed dry matter of 83.8 and 80.7 percent, respectively over unweeded check.

EFFECT ON CROP

Initial phytotoxicity was observed with molinate + propanil and EPTC + propanil which recovered in about 15 days.

The highest grain yield was recorded in hand weeding twice which was comparble with most of the herbicide treatments except EPTC + propanil. Uncontrolled weed growth resulted in over 50 per cent yield reduction. This yield trend was due to the result of effective control of grasses by the herbicides as the grass weeds accounted for about 60 per cent of total weed population.

Thiobencarb gave the higherst net income of Rs. 1.64 per rupee invested as against 1.52 for the hand weeding twice indicating the economic weed control through herbicides than by manual weeding.

GREENGRAM

EFFECT ON WEEDS

The major weed flora include *Echinochloa* spp; *Cynodon dactylon* and *Paspalum paspalodes*(=distichum). Thiobencarb recorded the lowest weed population (46.3/m²) followed by molinate + 2, 4 D EE (Table 3). This indicated the season long residual action by these herbicides on late germinating weeds (Ramamoorthy, 1985) . The population reduction was 72.7 and 71.6 per cent respectively for thiobencarb and molinate + 2, 4-D EE compared to hand weeding twice. The increased incidence of weeds in hand weeding twice might be the result of germination from soil seed bank which was contributed by weeds that escaped hand weeding.

EFFECT ON CROP

The percentage germination establishment and drymatter production on 30 days after sowing of

Table 3 Residual effect of treatments on weed characters (20 DAS) and yield of green gram

Treatment	Dose Kg/ha	Total weed count No/m²	Weed dry matter (g/m³)	Germination percentage	Dry matter production Kg/ha 30 DAS	Grain yield Kg/ha
Molinate	2.88	96.7 e	6.67 ab	82 3	541	734
Molinate 2. 4-DEE	1.80+ 0 56	46.6 a	4.74 a	86.7	558	747
Molinate+propanil	1.44+ 1.44	58.0 b	4.73 a	80.2	549	714
EPIC	2.88	67.7 bc	5.54 a	80.1	538	740
EPTC+2 4-DEE	1.12+ 0 56	91.3 e	8.84 b	84.3	546	748
EPTC+Propanil	1.44+ 1 44	76.0 cd	6.57 ab	81.6	518	716
Thiobencarb	1.50	46.3 a	4 66 a	85 5	570	786
Handweeding twice	—	80 0 d	6 71 b	90.0	540	747
Unweeded check	—	320.1 f	20.70 c	88.3	506	648
				NS	NS	NS

In a column any two means followed by anyone common letter are not significantly different from each ether by DMRT.

greengram was not influenced by herbicide treatments. Ths grain yield was not influenced by weed control treatments probably due to the hand hoeing and weeding given on 2)th day after sowing (Anon. 1985).

The study revealed that in situations of diversified weed flora herbicide mixtures can be effectively used to widen the spectrum of weed control. Thiobencarb at 1.5 kg/ha or molinate + 2, 4-D EE at 1.80 + 0.56 kg/ha to transplanted rice and one hand hoeing and weeding to succeeding greengram may be an effective weed management programme for rice-rice-pulse cropping system.

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