shape and uniformity in several fruit characters than do those of PMR 450. Both varieties are earlier maturing and more prolific than PMR 450 in Imperial Valley. Campo produces a large percentage of size 36, round-oval melons well-covered with round net and nearly free from sutures. Jacumba produces a large percentage of size 27 oval-shaped melons well-covered with round net on the ribs. The shallow, often bare sutures give the fruit a striped appearance, as shown in photo. The rind color of both varieties is yellow-green at full slip turning yellow at table maturity. The salmon-orange flesh is thick and sweet with a mild, aromatic, muskmelon flavor. Their rind hardness, flesh firmness, and cavity dryness should make Campo and Jacumba suitable for long-distance shipping. The seeds of Campo are typically yellow; those of Jacumba are typically cream-colored but occasionally a few yellow-seeded fruits are present. The fruits of Campo should be held at room temperature for three to 10 days and quick-chilled for eating; Jacumba fruits should be held at room temperature for five to 15 days and quick-chilled for eating.

Campo and Jacumba have performed well in experimental early spring plantings in Imperial and Palo Verde valleys of California and at Yuma, Arizona. They have not performed as well in the Lower Rio Grande Valley of Texas. Accordingly, Campo and Jacumba are recommended for trial in the early spring districts of California and Arizona, but not in the Lower Rio Grande Valley.

Observations on the new varieties in field plantings and recorded data on fruit samples secured at four locations in the early spring districts indicated that Campo and Jacumba were equal or superior to the varieties PMR 45 and PMR 450 in most characters used to estimate fruit quality (see table and photo comparisons). One hundred hill plots of Campo and Jacumba were earlier, more uniform, and more prolific than PMR 450 in a trial grown by the Arena Imperial Company near Brawley, Imperial County, during spring, 1964 (see photos).

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Watergrass Control In Rice Fields with PROPANIL *and* ORDRAM

DEEP-WATER CULTIVATION has been the only means of controlling watergrass in California rice fields where continuous flooding is the prevailing cultural practice. Hand weeding is uneconomical, and mechanical cultivation under "upland" conditions (irrigated but not flooded) does not produce enough rice to meet California standards.

Even deep-water control (minimum, 6 inches) is not always successful, however. Occasionally, grass grows where water is inadequately supplied, or when water temperature and soil fertility are such that minimum water depth is ineffective. Spring winds sometimes cause breaks in the levees, draining large portions of the field and allowing grass to survive. At other times, cool spring temperatures reduce rice seedling survival, and water must be lowered for satisfactory stands.

Preliminary testing at the Rice Experiment Station with 3, 4-dichloropropion anilide (propanil, trade names: Stam F-34 and Rogue) applied as a postemergence spray indicated that 2 or 3 lbs of active material per acre controlled watergrass at the two- or three-leaf stage with no damage to the rice. To insure contact of the spray with watergrass plants in this early stage, water had to be removed from the rice field before spraying, and then returned about 48 hours after spraying. This was possible in very small test plots or fields, where water could be removed or added quickly, but it is not feasible for large commercial fields where slow addition of water may result in germination of new grass seed or loss of soil nitrogen. Therefore, propanil was tested in 1962 and succeeding years using continuous shallow water. In the same year, *S*-Ethyl hexahydro-1 *H*-azepine-1-carbothioate (trade name Ordram), a granular material applied at the preflood stage was tested at the Rice Experiment Station, also using continuous shallow water.

TABLE 1. ESTIMATED WATERGRASS CONTROL AFTER PREFLOOD AND POSTEMERGENT TREATMENTS WITH PROPANIL AND ORDRAM IN 1963

Chemical	Application time* (days)	Rate (lb/A)	Estimated watergrass† (per cent)			
			Days after flooding			
			42	57	72	121
Control			76	79	82	76
Propanil	+ 22	4	31‡	62	44	57
	+ 35	6	20	0	1	0
Ordram	− 1	1	58	67	63	63
	− 1	3	21	17	23	24
	− 1	5	13	9	15	10

* Flooded on May 28; + means days after flooding; − means days before flooding.
† Estimated by several observers as a percentage of total stand.
‡ Average of five replications.

In 1963 and 1964, control of watergrass in plots treated with propanil and Ordram under shallow-water conditions was evaluated by several observers. Results shown in tables 1 and 2 indicate that although evaluations vary with changes in number of days after flooding, the chemicals effectively decreased watergrass during the growing period. Although observers noted the greatest reduction of watergrass when propanil was applied at a late date, this treatment may not be the most economical. Table 2 shows that in 1964 all propanil treatments except at 29 days greatly reduced watergrass. Treatment

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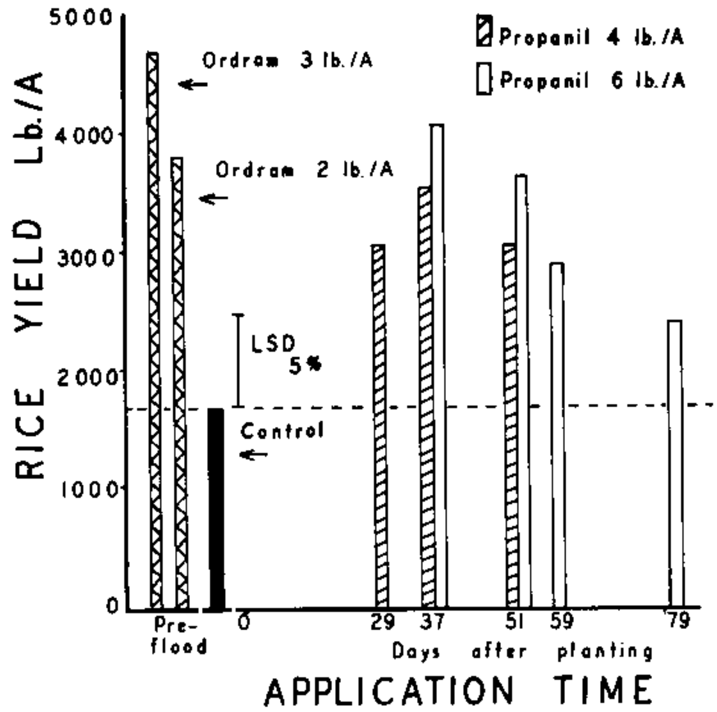

Paddy rice yield in 1964 (14% moisture) when treated with Ordram and propanil at different times and rates for watergrass control. Yield for plots treated with 3 lbs per acre of Ordram is the average of all 3-lb plots treated one and eight days before flooding. The 2 lbs of Ordram were applied one day before flooding.

If the 1950's became known to California rice growers as the years in which broadleaf weeds were finally controlled, then the 1960's appear to be the years in which grassy weeds—especially watergrass or barnyard grass—might also be brought under control with the use of selective chemicals. Preliminary tests and observations described in this report indicate that propanil, applied as a postemergence spray, and Ordram, a granular material applied at the preflood stage, may offer good control of watergrass in California rice fields which are continuously flooded during the growing season.

at 29 days and at 22 days (in 1963) was purposely applied immediately after the grass emerged from the water. At that stage—even under shallow-water conditions—an inadequate portion of the grass was sprayed. Thus, while early spraying is desirable to limit grass competition, the control may be inadequate. Where water is drained from the field, as is frequently done in the southern United States, the earlier dates may be satisfactory, however, this practice is not followed in California.

Preplant treatments of Ordram resulted in low grass incidence, according to observers, even at the early evaluation dates, when rates of 3 lbs or more of the active material were used per acre. Since control was immediate upon flooding the field, there was little difference in watergrass incidence between early and late observations. Naturally, evaluations of propanil-sprayed plots, where weeds had emerged, showed a much wider range of difference between first and last observations.

Table 3 shows the yields from propanil-sprayed plots for the years 1962, 1963, and 1964. It must be remembered, however, that the goal was weed control rather than maximum rice yield. Therefore, yields from sprayed plots may not appear to be extremely high until they are compared with the nontreated check plot. Also, these differences are the result of weed control rather than the effect of propanil on the rice, since fields sprayed with propanil when watergrass or other weeds were not a problem showed no significant increase in yield over the nontreated control. The visual evaluations of too-early spraying and the yield data for 1963 and 1964 also indicate the reduced yields from these too-early sprays. However, the best yields were realized from the sprays during the early tillering stage of rice (37 days in 1964) when grass was controlled before competition had adversely affected the rice. Furthermore, although the differences were slight, yields were higher in 1962 and 1964 with the 6-lb rate of application than with the 4-lb rate.

Increased yields from all the plots in all three years were economically sound—considering the current cost of the chemical and the current price received for rice.

Table 4 shows the yields of Ordram-treated plots from 1962 to 1964. Since this material had been tested previously at the pre-flood stage, the differences noted in the table are due basically to rate of application. Good increases in yield were obtained throughout the three years of testing as compared with the nontreated control. It can also be noted in all three years that 3 lbs of Ordram (active material) were as effective as the higher rates—with field variations accounting for whatever slight differences occurred. No adverse effect on the rice was observed even at the high rate of 12 lbs per acre. Rates of less than 3 lbs did not give as good control in 1963 or 1964.

In 1964, applications of Ordram were made more than one week before flooding

TABLE 2. ESTIMATED WATERGRASS CONTROL AFTER PREFLOOD AND POSTEMERGENT TREATMENTS WITH PROPANIL AND ORDRAM IN 1964

Chemical	Application time* (days)	Rate (lb/A)	Estimated (per cent) watergrass† (Days after flooding) 76	86	97	106
Control	..	..	95	85	90	90
Propanil	+ 29	4	75‡	55	70	75
	+ 37	4	60	55	60	50
	+ 37	6	45	30	50	25
	+ 51	4	70	60	45	35
	+ 51	6	40	35	20	20
	+ 59	6	55	45	30	15
	+ 79	6	100	80	50	30
Ordram	− 8	3	20	10	10	10
	− 8	3	15	10	10	5
	− 1	3	15	10	10	5
	− 1	2	50	50	40	35

* Flooded on April 21; + means days after flooding; − means days before flooding.

† Estmated by two observers as percentage of total stand.

‡ Average of four replications.

to see if the material would be lost under these conditions. No significant difference was found between these plots and the plots to which Ordram was applied only one day before flooding. Observations made on these plots did indicate that incorporation of this material by light harrowing gave slightly better control. Previous research indicates that light rains moistening this material prior to soil incorporation might cause a loss of active material. However, in these tests, Ordram was always applied on dry soil, and no rain fell between the time of application and flooding.

TABLE 3. YIELD OF RICE, WEED SEEDS AND DEBRIS FROM PLOTS SPRAYED WITH PROPANIL AT TWO RATES TO CONTROL WATERGRASS

Year	Application after flooding (days)	Yields (lbs/A) from plots sprayed with propanil at: 4 lb/A Paddy* rice	4 lb/A Weed seeds* and debris	6 lb/A Paddy rice	6 lb/A Weed seeds and debris
1962	36	3,000**	......	3,430**	......
	Control	300	......	800	......
1963	22	3,070	190	......	......
	35	......	......	3,820**	70
	Control	2,540	260	2,540	260
1964	29	3,100**	250	......	......
	37	3,500**	280	4,220**	300
	51	2,960**	300	3,520**	210
	59	......	......	2,920**	180
	79	......	......	2,400	160
	Control	1,830	330	1,830	330

* lbs per acre
** Significantly higher than untreated control at 1%.

TABLE 4. YIELD OF RICE, WEED SEEDS, AND DEBRIS FROM PLOTS TREATED WITH ORDRAM TO CONTROL WATERGRASS

Year	Ordram (lb/A)	Application before flooding (days)	Paddy rice (lb/A)	Weed seeds and debris
1962*	3	1	4,600	...
	6	1	4,670	...
	Control		4,120	...
1963†	1	½	3,160*	190
	3	½	3,470**	140
	5	½	3,350**	140
	Control		2,540	260
1964†	2	1	3,940**	270
	3	8	4,600**	160
	3	8‡	4,820**	140
	3	1	4,540**	140
	12	1	4,780**	170
	Control		1,830	330

* Liquid EC 6 lb/gal.
† 5% granular; applied with a ground-operated Gandy.
‡ Not incorporated into soil; rest in 1963 and 1964 incorporated with harrow.
* Significantly higher than control at 5%.
** Significantly higher than control at 1%.

Tables 3 and 4 show the amount of weed seed, mostly watergrass, and debris (straw, chaff, etc.) compared with the yields of paddy rice. In some years the differences found between yield of such material from treated and nontreated plots may be nearly 200 lbs per acre. If we assume that it costs 50 cents per cwt for harvesting, 25 cents per cwt for drying, and 15 cents per cwt for storage, each cwt per acre of extraneous material harvested with the rice will cost the rice grower about 90 cents. Reducing these costs is an additional advantage along with the increased rice yield.

TABLE 5. CORRELATION BETWEEN NUMBER OF PANICLES AND YIELD OF RICE FOLLOWING TREATMENT IN 1964 WITH PROPANIL AND ORDRAM FOR WATERGRASS CONTROL

Chemical	Application time* (days)	Application rate lb/A	Panicles per (2 sq ft†)	Yield (lb/A)
Control	..	.	24	1,830
Propanil	+29	4	38	3,100
	+37	4	47	3,500
	+37	6	42	4,220
	+51	4	52	2,960
	+51	6	46	3,520
	+59	6	40	2,920
	+79	6	28	2,400
Ordram	−8‡	3	51	4,600
	−8	3	54	4,820
	−1	3	66	4,540
	−1	2	24	3,940

* Correlation coefficient, .82—significant at 1%; + means days after flooding; − means days before flooding.
† Four replications.
‡ Not incorporated, remaining Ordram treatments incorporated by harrowing.

Effects on yield due to different application rates and timing of chemical control can be indicated by a count of rice panicles. Correlation of total yield and number of panicles per 2 sq ft gave the highly significant positive correlation of 0.82, shown in table 5. In all cases, regardless of rate and timing of propanil application, both total yield and the number of panicles per 2 sq ft were higher in the sprayed plots than in control plots. The greatest reduction of panicle numbers occurred when the watergrass was allowed to compete with rice for 79 days. All the plots treated with 3 lbs of Ordram per acre produced much greater numbers of panicles than did the 2-lb-per-acre treatment and the check—indicating again that early elimination of watergrass competition allows more panicle development.

Whether a grower chooses to use propanil as a postemergence spray over shallow water in fields already infested with watergrass or to use Ordram as a granular preflood material to control grass before it can become established, current recommendations on the manufacturer's label and those made by University of California should be followed.

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Recent field experiments indicate that commercial preparations of the nucleopolyhedrosis virus of Heliothis zea and the bacterium, Bacillus thuringiensis Berliner, offer much promise for effective and selective control of early instar bollworms on cotton.

THE BOLLWORM, *Heliothis zea* (Boddie), is a frequent pest of cotton in California. For nearly 20 years, it was effectively controlled with DDT and certain other chlorinated hydrocarbon insecticides. However, a build-up of resistance to DDT in recent years, has caused increasing control difficulties. Furthermore, severe use limitations have been placed on DDT and related materials, because they pose a contamination threat if they drift to crops adjoining cotton.

Control Materials

The need for improved control methods has resulted in an intensive research program now in progress to investigate the possibility of developing highly effective and selective control procedures against this pest. In 1964, cooperative field studies were conducted to determine the effectiveness of field applications of the nucleopolyhedrosis virus of *H. zea* and the bacterium, *Bacillus thuringiensis* Berliner, at different concentrations and to compare these materials with candidate experimental chemical compounds and with a recommended chemical insecticide. Materials used in the test were: Biotrol VHZ, a preparation of the nucleopolyhedrosis virus of *H. zea;* Thuricide 90T, a concentrated spore preparation of *B. thuringiensis;* Azodrin (crotonamide, 3 hydroxy-N-methyl-cis-dimethyl phosphate); Nia 10242 (2,2-dimethyl-2,-3-dihydro benzo furanyl-7 N-methylcarbamate); and carbaryl, a carbamate insecticide currently recommended for bollworm control.

Field experiments

Three field experiments were conducted in Kern County to test the value of the various materials when applied as sprays against populations of early instar (small) bollworms. The sprays were applied with a high-clearance, eight-row ground sprayer, utilizing five nozzles per row. The rate of application of dilute spray was 28 gallons per acre.

To thoroughly test the materials, severe bollworm infestations were created by augmenting the natural populations with