MIXTURES OF MCPA PLUS DICAMBA AND MCPA PLUS BROMOXYNIL IN CEREALS

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Summary

Aotea, Arawa, and Gamenya wheat tolerated 1.5 lb MCPA plus 0.25 lb dicamba between the 5-leaf stage and the 2- to 3-node stage. Hilgendorf showed some yield depression which was attributed to later growth stage at treatment (3 to 4 node).

Amuri oats was less tolerant of MCPA plus dicamba than Mapua at the 5-leaf stage. Both were more tolerant at 2 to 3 node than at 5 leaf.

Carlsberg, Research and Kenia barley were depressed in yield by 1.5 lb MCPA plus 0.25 lb dicamba. Yield depression at the 4½- to 5-leaf stage was not predictable on the basis of growth stage and appeared associated with growing conditions.

The barley varieties showed better tolerance of MCPA plus bromoxynil than of MCPA plus dicamba at the rates used.

MIXTURES of dicamba with MCPA now used extensively for "broad spectrum" weed control have been shown to affect production when applied at certain stages of growth and certain conditions of growth (Friesen and Dew, 1966). Early work with dicamba indicated differences in tolerance between wheat, oats and barley and between varieties within each of these crops. Trials with barley pointed to a lower tolerance of the variety Kenia to this mixture although strictly comparative data were lacking (Allen, 1966). A series of trials was laid down in Canterbury during 1966-7 and 1967-8 seasons to investigate the yield response, in the presence of few weeds, of the principal wheat, oat and barley varieties grown in the province. A bromoxynil plus MCPA mixture was added to the barley series because of its potential wide weed spectrum and the prospect of greater crop tolerance.

EXPERIMENTAL

A simple factorial design with randomized block layout was used. The two chain long plots were drilled at 5 ft centres using a 7 coulter drill with 7 in. row spacing. Plots were sprayed with a bicycle-wheel-mounted boom sprayer pushed at the speed (time per plot) required to deliver 20 gal per acre at 30 lb/sq. in. pressure. They were harvested by direct heading.

Two rates of dicamba plus MCPA at two times of application plus untreated control were used for the wheat and oat trials, while the barley trials included bromoxynil plus MCPA at two rates and two times. In 1967-8, MCPA alone was added as a standard in all trials while at Leeston MCPA was included factorially.

The highest rate of chemical used commercially was taken as the base rate (X) and twice this quantity (2X) as the second rate, namely:

MCPA + dicamba*: $X = 0.75 + 0.125$

MCPA + bromoxynil: $X = 0.213 + 0.213$

MCPA: $X = 0.75$

* All rates in lb acid equivalent per acre.

The MCPA plus bromoxynil was a proprietary ester formulation while potassium salt MCPA and amine dicamba were tank mixed.

Times of application were intended to coincide with the beginning (T = tillering) and end (J = jointing) of the recommended spraying period (Woodford and Evans, 1965). In practice, owing to soil conditions, wind, and varietal differences in rate of development, exact timing was not achieved. Stages of development are indicated in Tables 1 and 3. Leaf number refers to leaves of the principal tiller. A leaf was taken as fully developed when it equalled in length the previous leaf and immature leaves were estimated in tenths. Jointing (stem extension) was recorded as the number of nodes easily detected when the principal tiller was run through the thumb and finger. The first applications would fall between Feekes 4 and 5 and the second between Feekes 7 and 8 (Large, 1954), while 4.8 leaf would be classified 5 leaf by Chancellor (Chancellor, 1966).

RESULTS AND DISCUSSION

GROWTH EFFECTS

Visible effects of treatment were restricted almost entirely to MCPA plus dicamba treatments and had their most marked expression in barley. The only effect noted in wheat was a slight reduction in height of Hilgendorf at the 2X rate of MCPA plus dicamba at jointing.

Stem bending occurred in barley and oats at both times of application, causing the crops to have a tangled flattened appearance for from one to three weeks.

Irregularity of grain arrangement within the ear and grain splitting was a characteristic consequence of tillering stage treatment with MCPA plus dicamba though the symptom was also occasionally present in the 2X rate of MCPA and of MCPA plus bromoxynil (Fig. 1).

TABLE 1: WHEAT AND OAT TREATMENT TIMES

<i>Crop, Locality and Planting Date</i>	<i>Variety</i>	<i>Days from Planting and Development Stage</i>			<i>Nodes</i>
		<i>First Spray</i>	<i>No of Leaves</i>	<i>Second Spray</i>	
Wheat Tai Tapu 3/10/66	Aotea	35	4.5	63	3
	Arawa	35	4.6	63	3
	Hilgendorf	35	4.7	63	3
	946/01	35	4.3	63	3
	Gamenya	35	4.2	56	3
Wheat Lincoln 13/6/67	Aotea	114	5.5	136	3
	Arawa	114	5.6	136	4
	Hilgendorf	114	6.2	136	4
Oats Springston 30/9/66	Amuri	34	5.1	61	3
	Mapua	34	5.2	61	4
	Onwards	34	4.6	61	3
Oats Templeton 29/9/67	Amuri	35	4.5	55	2
	Mapua	35	4.7	55	2

Treatment at jointing stage with 2X MCPA plus dicamba caused whitening and crimping of the margin of the flag leaf sheath accompanied by ear-trapping, kinking of awns and sterility of a variable number of spikelets at the tip of the ear (Fig. 2). Slight reduction in height and delay in maturity occurred with 2X rate MCPA plus dicamba at jointing on oats and barley and at the 2X rate at tillering on Amuri oats.

Fig. 1: Carlsberg barley sprayed early tillering (4.8 leaf) 1.5 lb MCPA + 0.25 lb dicamba. Awns removed to show localized spikelet abnormalities. —C. J. Miles Photo.

TABLE 2: WHEAT AND OAT YIELDS (BU./ACRE)

Locality	Treatment	Rate	Stage	Aotea	Arawa	Hilgendorf	Gamenya
WHEAT TRIALS							
Tai Tapu 66/67	Control	X*	T*	37.9 defB-H	35.5 efE-H	38.5 defB-H	55.4 abAB
	MCPA + dicamba	2X	T	35.6 efE-H	38.5 defB-H	33.8 efGH	53.8 abAB
		X	J	36.4 defC-H	34.9 efF-H	37.1 defC-H	51.3 abcA-E
		2X	J	36.0 defD-H	33.3 efGH	38.2 defB-H	52.6 abA-C
	CV 14.6%		J	36.0 defD-H	34.6 efF-H	31.3 fH	53.6 abAB
Lincoln 67/68	Control	X	T	61.7 bAB	55.8 bcB	41.9 eDE	
	MCPA	X	J	70.7 aA	56.0 bcB	40.9 eDE	
	MCPA + dicamba	2X	J	69.0 aA	55.2 bcB	41.5 eDE	
		X	T	71.5 aA	55.2 bcB	41.9 eDE	
	CV 7.9%	2X	J	71.0 aA	56.3 bcB	45.1 deCD	
Oat TRIALS				70.6 aA	52.0 cdBC	38.0 efDE	
		2X	J	69.6 aA	55.9 cdB	31.5 fE	
Springston 66/67	Control	X	T	105.4 abcdABC	114.3 abcABC	90.4 cdC	
	MCPA + dicamba	2X	T	107.4 abcABC	121.6 aA	86.9 dC	
		X	J	88.2 dC	108.1 abcABC	94.3 cdBC	
		2X	J	101.0 bcdABC	94.6 cdBC	97.7 cdABC	
	CV 9.6%		J	91.9 cdC	98.7 cdABC	92.9 cdC	
Templeton 67/68	Control	X	T	69.2 fDE	97.0 abA		
	MCPA + dicamba	2X	T	73.4 efCD	100.0 aA		
		X	J	69.7 fDE	94.2 abA		
		2X	J	59.4 gE	90.5 bcAB		
	CV 9.3%		J	80.4 deBC	100.4 aA		
				83.7 cdBC	95.9 abA		

* See text and Table 1 for exact rates and stage of growth.

YIELD OF GRAIN

Wheat

Differences in yield between varieties were significant in both trials. At Lincoln the 2X rate at jointing reduced the yield of Hilgendorf relative to Hilgendorf control. Because, in this trial, treatment at jointing was, overall, significantly lower yielding than treatment at tillering,

Fig. 2: *Kenia barley* sprayed at jointing (3 node) 1.5 lb MCPA + 0.25 lb dicamba. Shows awn kinking and sterile spikelets at top of ear. —C. J. Miles Photo.

it is probable that this difference in yield of Hilgendorf (also approaching significance at Tai Tapu) is due to the later treatment of this variety in relation to stage of development rather than an indication of difference in varietal susceptibility.

The site proved weedy and Aotea showed increased yield following treatment. There was no obvious reason for the failure of Hilgendorf and Arawa to respond.

Oats

Mapua yielded significantly more than other varieties at both sites. There were no treatment differences at Springston. At Templeton, Amuri showed marked responses. While it is accepted that oats are more tolerant to phenoxyacetic acid derivatives at later stages of growth up until jointing, the yield increase of Amuri at jointing is more likely to have been the result of delayed maturity leading to reduced wind damage. Since the growth stages at treatment were similar, it is possible that the differences in yield and growth response at tillering were due to difference in varietal susceptibility between Amuri and Mapua.

Barley

In the 7 trials there were 21 cases where treatment yield differed significantly from the corresponding variety control. Fifteen of these represented a decrease in yield and 6 an increase. Of the latter, 5 were from the Kenia plots of the Lakeside 1967-8 trial. This is considered misleading since the Kenia control did not give a reliable estimate of the yield potential of the site because two control plots fell on finishes which became waterlogged following heavy rain shortly after crop emergence. This opinion is supported by the fact that, though there were very few weeds, the MCPA standard yielded significantly more than the control.

Of the above 15 significant reductions in yield, 13 were MCPA plus dicamba treatments. Five of these were also significantly lower than the corresponding MCPA plus bromoxynil treatment. Of the 52 comparisons between comparable rates and times of application of the two mixtures, MCPA plus bromoxynil yielded more than MCPA plus dicamba 38 times (5 significantly) while MCPA plus dicamba was ahead on 13 occasions (1 significantly) and once yields were equal.

In the overall comparison of the X versus 2X rate, the high rate was significantly lower yielding in all but the Leeston 66/67 trial. Inspection of the data indicates that doubling the MCPA plus dicamba rate depressed yield more than doubling the MCPA plus bromoxynil rate. MCPA plus dicamba reduced yield significantly on 4 occasions at the X rate to once by MCPA plus bromoxynil. These points, together with the previous paragraph, support the contention that barley varieties are more tolerant of herbicidal rates of MCPA plus bromoxynil than of similar rates of MCPA plus dicamba. The X rate of MCPA plus bromoxynil used in these trials is at about the maximum level allowing for twice times crop tolerance, while the X rate MCPA plus dicamba is in excess of this quantity.

Treatment with MCPA plus dicamba at tillering reduced yields at Lakeside 66/67 and Leeston 67/68, while treatment at jointing reduced yields at Tai Tapu, Leeston 66/67 and Clarkville, as well as at Leeston 67/68. Inspection of Table 4 shows that differences of growth stage

TABLE 3: BARLEY TREATMENT TIMES

Locality and Planting Date	Variety	Days from Planting and Development Stage			
		First Spray	No. of Leaves	Second Spray	Nodes
Lakeside 21/10/66	Carlsberg	31	4.8	53	2
Tai Tapu 18/10/66	Research	31	4.8	55	3
	Carlsberg		4.8		3
Leeston 20/10/66	Research	29	4.8	55	3
	Kenia		4.5		4
Clarkville 4/10/66	Carlsberg	31	4.5	57	4
	Kenia		4.3		4
Templeton 29/9/67	Research	33	4.8	53	3
	Carlsberg		5.0		3
Lakeside 17/10/67	Carlsberg	36	4.8	49	2
	Kenia		4.4		2
Leeston 12/10/67	Research	40	5.0	54	3
	Kenia		4.5		3

at time of treatment were small. At tillering treatment time, Clarkville had the youngest growth stage but showed no effect (though approaching significance at 2X). The oldest in terms of time elapsed from planting, Leeston 67/68, showed yield reduction while the youngest, Leeston 66/67, showed no response. Growth rate at spraying may be the response determining factor (Friesen and Dew, 1966). Lakeside 66/67 and Leeston 67/68 were treated when the soil surface was moist after heavy rain and the crops accelerating in growth as a consequence. Lakeside 67/68 and Templeton had similar moisture conditions but the former was still checked from earlier flooding while cool, less favourable, growth conditions prevailed at Templeton for several days after treatment.

The response at jointing is more clear-cut. In the trials where responses occurred, the varieties were the more mature.

There was no difference between varieties in response to MCPA plus bromoxynil while, though field observation suggested an increase in susceptibility to MCPA plus dicamba from Carlsberg through Research to Kenia, yield response could also be explained on the basis of differences in stage of growth at treatment.

WEED CONTROL

Californian thistles (*Cirsium arvense*) were present in 5 of the trials. Some regrowth occurred in MCPA plus bromoxynil plots and appeared to be more marked in the jointing treatments. Control was adequate for these light infestations but the mixture would be unsuitable for heavy infestations or where the cereal crop was being used as part of a thistle control programme.

CONCLUSIONS

The results support present commercial recommendations for the use of MCPA plus dicamba, with respect to rates of chemical and stages

TABLE 4: BARLEY YIELDS (BU./ACRE)

Locality	Treatment	Rate	Growth Stage	Research	Carlsberg	Kenia
Lakeside 66/67	Control	X*	T*		105.9 aAB	
	MCPA + dicamba	2X	T		86.1 cdCD	
	"	X	J		81.8 dD	
	"	2X	J		101.8 abABCD	
	MCPA + bromoxynil	X	T		101.5 abABCD	
	"	2X	T		99.4 abcABCD	
Tai Tapu 66/67	"	X	J		89.0 bcdBCD	
	"	2X	J		110.2 aA	
	CV 8.0%		J		103.1 aABC	
	Control			105.5 aA	106.0 aA	
	MCPA + dicamba	X	T	96.9 abAB	104.5 aA	
	"	2X	T	100.2 abA	104.8 aA	
Leeston 66/67	"	X	J	100.7 abA	94.2 abAB	
	"	2X	J	79.1 cB	89.1 bcAB	
	MCPA + bromoxynil	X	T	102.6 abA	98.0 abA	
	"	2X	T	96.7 abAB	99.4 abA	
	"	X	J	108.5 aA	100.2 abA	
	"	2X	J	99.1 abA	101.0 abA	
Clarkville 66/67	CV 7.4%			91.7 abcA	96.1 abA	
	Control	X	T	86.3 abcA	89.3 abcA	
	MCPA + dicamba	2X	T	99.6 abA	91.4 abcA	
	"	X	J	91.2 abcA	79.1 cA	
	"	2X	J	80.5 cA	82.6 bcA	
	MCPA + bromoxynil	X	T	84.3 abcA	93.0 abcA	
Clarkville 66/67	"	2X	T	88.8 abcA	85.7 abcA	
	"	X	J	94.3 abcA	82.2 cA	
	"	2X	J	90.8 abcA	92.1 abcA	
	CV 9.6%					
	Control	X	T		121.1 aAB	105.3 bcdeABC
	MCPA + dicamba	2X	T		121.2 aAB	104.5 cdeABC
Clarkville 66/67	"	X	J		109.1 abcdABC	92.9 eCD
	"	X	J		119.3 abAB	94.2 eCD

of growth of crop, and indicate the likely adverse effect on the crop plant of treatment outside the set limits.

Wheat can be treated safely between 5-leaf and early 2-node stage with up to 0.75 lb MCPA plus 0.125 lb of dicamba.

Oats should not be sprayed until beyond the 5-leaf stage nor after early 3-node stage and the dose rate should be kept appreciably below 0.75 lb MCPA plus 0.125 lb dicamba, more especially in the case of Amuri.

Barley should be sprayed within the limits of the 5-leaf and 2-node stage at rates below 0.75 lb MCPA plus 0.125 lb dicamba. Indications are that spraying at tillering should be made when the crop is growing steadily and not shortly after a boost in growth initiated by a change in weather.

Barley appears more tolerant of the MCPA plus bromoxynil mixture at rates required for acceptable weed control than of similar rates of MCPA plus dicamba. Tolerance at tillering is an advantage in annual weed control and allows a small increase in the time available for spraying.

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