INTER-RELATIONSHIPS BETWEEN FERTILITY AND WEED CONTROL

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In any crop management system, numerous factors interact to result in a final yield. Two major factors are herbicide and fertilizer inputs. Unfortunately, the roles of each of these inputs as crop production tools have been studied in isolation relative to one another. Consequently the relationships between fertility and weed control are not well understood, leading to a situation where herbicide recommendations are made on the assumption that fertility has already been adequately looked after while fertilizer recommendations are prepared based on the assumption that an adequate weed control program will be undertaken. Either one or both of these assumptions may be wrong, leading to losses in yield potential, production efficiency, and the dollars invested.

Interactions between fertility and weed control begin even prior to emergence of the crop and weeds.

TABLE 1

EFFECT OF FERTILIZER NITROGEN ON GERMINATION OF WILD OATS

NITROGEN kg/ha	WILD OATS plants/m^2
0	71
28	83
56	93

The data in Table 1 are an example of the stimulatory effect nitrate fertilizers may have on wild oat germination. In this particular case, 56 kg/ha of nitrogen applied as ammonium nitrate resulted in a 31% increase in the wild oat population. Unless this wild oat population is controlled, the fertilizer application may turn out to have been an exercise in futility.

Fertilizers increase crop yields by providing the growing crop with an improved supply of plant nutrients (Table 2).

TABLE 2

EFFECT OF NITROGEN FERTILIZER ON THE YIELD OF WEED-FREE WHEAT

NITROGEN kg/ha	WHEAT kg/ha
0	1960
22	2290
44	2500
66	2470

Unfortunately, these nutrients will also promote the growth of weeds present in the field.

From Table 3, we see that weeds often respond to fertilization even more dramatically than do our crop species.

TABLE 3

EFFECT OF FERTILIZER NITROGEN ON THE SEED YIELD OF WILD OAT AND GREEN FOXTAIL GROWN IN COMPETITION WITH WHEAT

NITROGEN kg/ha	WILD OAT kg/ha	GREEN FOXTAIL kg/ha
0	69	6.8
22	71	16.2
44	141	17.5
66	141	24.0

In this case, 66 kg/ha of nitrogen doubled the seed yield of wild oats and quadrupled the seed yield of green foxtail. These increases in the yield of weed seed are at the expense of crop yield as the weeds luxuriously devour the added nutrients. The effect of this weed competition on crop yield is shown in Table 4.

TABLE 4

EFFECT OF FERTILIZER NITROGEN ON THE YIELD OF WHEAT

NITROGEN kg/ha	WEED-FREE kg/ha	WEEDY kg/ha
0	1960	1200
22	2290	1410
44	2500	1430
66	2470	1730

The combination fertilizer-herbicide treatment resulted in a 100% increase in yield. The use of herbicide maximized the benefit derived from the fertilizer and vice-versa.

The benefit derived from using a herbicide treatment in combination with the fertilization program depends upon the competitive ability of the crop. For example, in the case of a competitive crop such as barley, the stimulation of crop growth through fertilization may be sufficient to smother any weeds present. In my next example (Table 5), the application of 30 kg/ha of nitrogen had a much larger effect on barley yield than did the use of the herbicide difenzoquat.

TABLE 5

INTERACTION BETWEEN NITROGEN FERTILIZER AND DIFENZOQUAT HERBICIDE WITH RESPECT TO BARLEY YIELD AT LACOMBE.

	BARLEY YIELD kg/ha
Control	1950
Difenzoquat	1830
N (30 kg/ha)	2920
Difenzoquat + N	3660

Again the use of both herbicide and fertilizer maximized yield. In this case, the interaction arises for two reasons. Firstly, all herbicides are most effective when applied to actively growing weeds, and secondly herbicides such as difenzoquat which stunt wild oats rely on strong crop competition to finish the job. As a result, we often find a synergistic interaction fertility and weed control.

If we now look at a less competitive crop such as flax (Table 6), it is apparent that fertilization is a total waste of time unless weeds are controlled. Once weeds have been controlled, additional benefit may be achieved through the use of fertilizer.

TABLE 6

INTERACTION BETWEEN NITROGEN FERTILIZER AND DICLOFOP-METHYL HERBICIDE WITH RESPECT TO FLAX YIELD

	FLAX kg/ha
Control	15
N (30 kg/ha)	12
Diclofop methyl	124
Diclofop + N	141

These generalizations hold true when fertilizer nutrients are equally available to both crop and weeds. Nitrate nitrogen is relatively mobile in the soil and it will normally be equally available to both the crop and weeds even if attempts are made to band it close to the crop seed. Phosphate is another story however. As phosphate is basically nonmobile in the soil, it is possible to give the crop a competitive advantage with respect to the utilization of fertilizer phosphate simply by banding the phosphate with the seed (Table 7).

TABLE 7

EFFECT OF P FERTILIZER PLACEMENT ON THE YIELD OF BARLEY AND WILD OAT SEED

	SEED YIELD (kg/ha)	
PLACEMENT	BARLEY	WILD OAT
No P applied	1640	55
Broadcast	3920	68
Barley	5200	17

Thus, where phosphate is a major factor limiting plant growth, a light weed infestation may be successfully overcome through the use of a wise fertilizer program. The added phosphate, by improving the nutrient status of the crop also gives the crop a competitive advantage for other nutrients such as nitrogen (Table 8). It is important that the fertilization program be based on soil testing in order that the added fertilizer optimizes crop growth at the expense of weed growth. Adding large quantities of nitrogen when phosphate is limiting may simply fuel weed problems which do not have

such a high phosphate requirement.

TABLE 8

EFFECT OF P ON NITROGEN UPTAKE BY BARLEY AND WILD OATS

P PLACEMENT	NITROGEN UPTAKE (kg/ha)	
	BARLEY	WILD OAT
No P applied	175	82
With barley	309	11

Similarly, the herbicide program must be carefully tailored to the individual field situation or potential gains as a result of fertilization may be lost. For example, green foxtail responds to nitrogen in a way that is almost scarry. In one study conducted by Al Sturko at the University of Manitoba, fertilization stimulated foxtail growth to such an extent that the foxtail yielded more than did the wheat (Table 9).

TABLE 9

EFFECT OF ADDED NITROGEN ON THE YIELDS OF WHEAT AND GREEN FOXTAIL

NITROGEN	YIELD (kg/ha)	
kg/ha	WHEAT	GREEN FOXTAIL
0	551	107
33.6	530	401
67.3	487	498
100.9	420	578

If a farmer employs a wild oat herbicide and fertilizer, the investment in both may be lost if green foxtail is present. The increasing use of wild oat herbicides and fertilizers is undoubtedly a major factor contributing to the rapid spread of green foxtail as a major weed problem. The development of hemp nettle as a significant weed problem also appears to be associated with an increase in the use of fertilizers in combination with herbicides which control weeds other than hemp nettle. Just as it is important to tailor the fertilizer program to the individual field, it is also important to develop a weed control program which will protect that fertilizer investment.

In conclusion, it can be stated unequivically that the wise use of both fertilizers and herbicides is required to maximize productivity. The fertilizer program must be based on a soil test in order to ensure that the competitive ability of the crop is maximized. The herbicide program must be just as carefully planned. The use of herbicides which do not control the complete spectrum of weeds present in a particular field may simply allow fertilizer to be utilized by the remaining weed species with the result that both the fertilizer and the herbicide investments are wasted. Decisions as to which input should be shaved in times when resources are insufficient to pay for optimal fertilization and weed control must be based on the total complex of factors influencing production on any given parcel of land ie. nutrient status, weed populations, crop to be grown, water status, etc., etc.. No sweeping generalizations such as

cut herbicide use first or cut fertilizer use first can be made. Finally, we must conclude that an intensive effort is required to evaluate fertility weed control interactions in cereal and oilseed crops in order to provide extension personnel with the facts they require in order to educate and counsel agricultural producers with respect to increasingly expensive fertilizer and herbicide input decisions.