F. Yates

Reprinted from

Experimental Husbandry Farms and Experimental Horticulture Stations

Eleventh Progress Report 1970

1970

MULTI-LEVEL NITROGEN TESTS FOR CEREALS

D. A. Boyd, *Rothamsted Experimental Station*

The starting point for this new series of experiments was some fresh information on the relationship between nitrogen dressings and crop yields. As much for statistical convenience as from physiological reasoning this relationship, usually called the 'response curve', has generally been assumed to follow a simple curve, of exponential or quadratic form. In the past, most experiments tested only 3 or 4 amounts of nitrogen, too few to give more than a very general indication of the response curve. However, examination of two series of experiments testing 5 and 6 amounts of nitrogen for sugar beet* showed that, for sugar yield, response to nitrogen was often less well represented by a curve than by two straight lines. A similar finding for cereals could affect manurial recommendations and so the new experiments will test many dressings of nitrogen.

Typically, increasing amounts of nitrogen at first increase sugar yield rapidly and almost linearly. When still more nitrogen is given, yield of tops goes on increasing whereas for sugar yield there is a quite sharp transition to a second line with yield changing little or even decreasing slightly. It seems that once a critical leaf density has been reached, depending on characteristics of the site, crop and season, nitrogen cannot increase sugar yield further. This situation resembles the so-called 'Law of Limiting Factors' put forward by Liebig over a century ago.

There is good reason to think that, for cereals also, a more detailed knowledge of the form of the response curve, coupled with a more systematic investigation of the reasons for differences of response from place to place, and year to year, could help growers to anticipate their crops' needs more correctly. Preliminary tests of seven amounts of N, from 40 to 160 units N per acre, made in 1969 with a seventh successive winter wheat crop at High Mowthorpe, and of eight amounts from 0 to 105 units N per acre, made with spring barley at Rosemaund, were each well fitted by a single straight line, whereas the responses to eight amounts from 40 to 180 units N per acre on the thirteenth successive barley crop at Boxworth were well represented by two straight lines, the optimum being about 120 units N per acre. In addition, a small series of experiments with spring barley has already been completed in the N.A.A.S. South Western Region, and others testing six amounts are in progress in the Northern and South Western Regions. These suggest that for cereals also the idea of representing response to nitrogen by one or two straight lines may prove a useful one. Although results for most sites seem to conform to this pattern, the nitrogen/yield relationship is likely to be more complex than for sugar beet. Thus it would be surprising to find that the indirect effect of nitrogen through disease and lodging always affected yield linearly.

---

*Results of these and other experiments with N for sugar beet are given by Boyd, Tinker, Draycott and Last, J. agric.Sci., **74**. 37–46 (1970).

Yields of grain from multilevel nitrogen tests on three E.H.Fs. 1969
(cwt/acre)

	units N/acre								S.E.
	40	60	80	100	120	140	160	180	±
High Mowthorpe	15·9	18·8	21·6	25·2	28·7	30·4	30·7	—	0·81
Boxworth	24·2	26·3	28·7	31·2	31·6	33·5	33·0	23·9	0·84

	units N/acre								S.E.
	0	15	30	45	60	75	90	105	±
Rosemaund	17·2	23·4	22·4	29·0	32·3	32·8	36·8	39·9	1·79

For both crops the relative importance of the two portions of the nitrogen/yield relationship differs greatly from experiment to experiment: on some sites responses were solely on the upper portion of the curve, indicating that the soil was rich enough to supply all the nitrogen needed by the crop, or where yields were poor that some other factors inhibited response to nitrogen. In contrast to sugar beet, some cereal crops show large yield decreases from extra nitrogen once the transition point is reached; indeed, at Woburn in 1968 the yield of spring barley decreased almost linearly from 32·5 cwt per acre with 40 units N per acre to only 23·5 cwt per acre with 160 units N per acre. On most sites response on the rising portion of the response curve is about 25 cwt per 100 units N for both sugar and grain yield (the similarity has no physiological significance), but on some sites the rate of increase is much less; the transition point may then not be reached without very large dressings, as at High Mowthorpe in 1969, when the unusually wet spring may have leached nitrogen before it could be taken up by the growing plant. Diseases and poor soil conditions could have similar results. An important aim of the new investigations will be to try to explain such differences in response from place to place, and from year to year, and to see how far they can be predicted.

HERBICIDES FOR WILD OAT CONTROL

M. Selman, *Boxworth Experimental Husbandry Farm*

The two herbicides currently in common use for the control of wild oats are the soil-incorporated spray tri-allate, and barban which is applied post emergence. Each has disadvantages. Tri-allate requires a good tilth for its incorporation and this may be difficult to produce in the autumn for winter