ZINC RESPONSES IN OILSEED RAPE (*BRASSICA NAPUS*).

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ABSTRACT

The response of oilseed rape seedlings to post-transplanting zinc (Zn) supply was examined in seven field experiments in Hubei province, central China. Seedlings were transplanted at 4-6 leaf stage into mainfields treated with seven Zn levels from 0-45 or 0-60 kg $ZnSO_4$/ha in late October to mid November. Increasing Zn increased shoot dry matter (DM) of plants at rosette stage by up to 100 %, at green bud stage by up to 28 % and seed yield by up to 18 %. Zinc fertilisers stimulated seed yield or growth in six out of seven experiments including those on soils with up to 0.84 mg Zn/kg. That oilseed rape plants from rosette stage through to flowering contained more than adequate Zn in their young leaves for growth suggests plants were free of Zn deficiency for all but a short period after transplanting. The strong relative responses of oilseed rape to Zn at rosette stage, and the weakening of the response with time suggests that oilseed rape experienced a temporary Zn deficiency after transplanting which limited final seed yield. The significance of these results for the nutrition of transplanted oilseed rape crops is discussed.

INTRODUCTION

Transplanting is the usual practice for establishing winter rape in most of China. Transplanted seedlings may be exposed to dry periods, waterlogging, or sub-zero temperatures. The rapid recovery of the seedlings from transplanting is considered to be a pre-requisite for successful overwintering by the plants so that they can exploit the increasing temperatures and rainfall availability in the late winter and early spring.

In the present study, the objective was to examine the response of seed yield of transplanted oilseed rape to Zn fertiliser. Effects of Zn treatments on plant growth, leaf Zn concentrations and seed yield were determined.

EXPERIMENTAL

Seven field experiments were set up in Hubei province, central China. Seven Zn rates were applied as follows:

0, 3, 6, 9, 15, 30, 45 kg $ZnSO_4$/ha - Experiments 1, 6, 7

0, 7.5, 11.25, 15, 22.5, 30, 60 kg $ZnSO_4$/ha - Experiments 2, 3, 4, 5

Basal fertiliser was added at 150 kg N/ha; 40 kg P/ha; 95 kg K/ha; 24 kg S/ha; and 1.2 kg B/ha. Oilseed rape *cv.* Zhongyou 821 (Experiments 1 and 2) or Zhongshuang 4 (Experiments 3-7) seeds were sown into seed beds in late September for transplanting in late October to mid November at a density of 132,000 plants/ha. Youngest mature leaves (YML) in these experiments were sampled at rosette stage in late December- early January (Code 1,7-1,10 according to Sylvester-Bradley 1985). At green bud and at rosette stages in Experiments 3-7, whole shoots of 10 plants per plot were harvested for dry matter. At maturity, seed was harvested for yield.

At five sites in Hubei province with a range of soil properties and DTPA extractable Zn levels of 0.26 to 0.84 mg/kg, Zn fertiliser increased seed yield of oilseed rape by 9 to 18 %. Zinc fertiliser failed to increase growth or seed yield at only one out of seven sites. Combined with the results of previous research in central China which has shown 10 - 20 % seed yield increases to Zn fertiliser in 12 field experiments with oilseed rape (Xie *et al.* unpublished data), there is clear evidence that yields of oilseed rape can be increased significantly by Zn fertiliser albeit by less than 20 %. Zinc fertiliser rates of 3 to 15 kg $ZnSO_4$/ha were sufficient to reach maximum yields.

Surprisingly, most YML Zn concentrations in unfertilised plants were > 30 mg/kg at rosette stage. Yet our results suggest that plant growth is not depressed until Zn concentrations in the YML approach 6-9 mg Zn/kg (Huang *et al*, these proceedings). Neither of these reports supports the argument that plants were deficient in Zn from late December when first sampled through to mid February (Experiments 3-7) or mid March (Experiments 1 and 2). Neither is it likely that Zn deficiency occurred later in crop growth since growth responses were generally already evident at the rosette stage and the relative response to Zn fertiliser weakened with time (Table. 1).

Oilseed rape has the reputation from direct sown crops for responding only infrequently to Zn fertiliser (Grant and Bailey 1993). That the present crops responded in six out of seven experiments to Zn fertiliser suggests that it was transplanting and its consequences for Zn uptake that increased sensitivity to Zn deficiency. In the present study, the deficiency of Zn was temporary having passed within 6-9 weeks after transplanting. In central China, transplanted oilseed rape seedlings take up to 4 weeks to recover from transplanting suggesting that it takes at least that long for new root growth to occur. Secondly, like Zn, P fertiliser increased shoot dry matter at the rosette and green bud stages leading later to increased seed yield (data not shown). The response to P fertiliser, like that to Zn, evidently occurred early in crop growth soon after transplanting and probably as a consequence of it.

The extent to which Zn deficiency limits post-transplanting growth of oilseed rape may vary with the duration of the recovery phase and particularly on those conditions that limit new root growth. That both P and Zn fertiliser increased growth and yield suggests that other deficiencies may limit the post-transplanting growth of oilseed rape. Particular attention should be given to elements which like P and Zn are immobile in the soil. The recovery of root function, especially rhizosphere modifications that enhance the availability of elements such as Zn and P could be a fruitful area for investigation.

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Table 1. Effect of Zn supply on relative shoot dry matter (plus Zn as a % of nil Zn added) at rosette and green bud stages, and on relative seed yield of oilseed rape at five sites in Hubei, central China with increasing levels of DTPA extractable Zn (mg/kg) in the soil at 0-20 cm . nd - no data. *, significant at P=0.05. No shoot dry matter data was collected in Experiments 1 and 2.

	Expt				
	3	4	5	6	7
DTPA Zn	0.28	0.47	0.49	0.84	0.56
Rosette shoot DM	150*	200*	131*	nd	109*
Green bud shoot DM	111*	125*	113^{NS}	128*	116*
Seed yield	nd	110*	111*	118*	109*