STEM EXTENSION IN WINTER OILSEED RAPE

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ABSTRACT

There was a wide variation in the thermal time accumulated from sowing to the onset of stem extension in six cultivars grown at two Scottish sites over three years. However, the shoot dry weights at the time of stem extension were similar. The availability of photosynthate appears to limit stem extension in crops with poor winter vigour. Unfortunately, winter vigour is difficult to predict.

INTRODUCTION

The first low glucosinolate winter rape cultivars tended to be taller than their high glucosinolate predecessors and prone to lodging during the flowering period in Scottish trials and farms. The selection of cultivars or breeding lines for resistance to lodging is hindered by the unpredictable nature of the storms and the stage of development at which they occur. A better understanding of stem growth and development should therefore suggest characters associated with lodging resistance which would be more amenable to selection. We have suggested that short internodes are associated with lodging resistance (Fisher and Walker, 1992). Thus our most resistant cultivar (Rocket) had as many internodes as any other cultivar but they were short. Other more susceptible cultivars (eg Envol) had short stems with fewer but longer internodes. Short internodes are an easy character for which to select.

The present purpose is to describe attempts to explain the seasonal and site variation in the onset of stem growth and final stem length.

EXPERIMENTAL

Cultivars with contrasting plant type were sown in three replicates within large rape fields at sites in the Forth valley near Edinburgh in harvest years 1991 to 1993 and at Tillycorthie Farm, Udny, Aberdeenshire in 1992 and 1993. They were sown between 26 and 30 August at a seedrate of 6 kg/ha. At two to three week intervals from the beginning of November to the end of stem extension, plants were taken at random from the plots and recorded for apical development stage, leaf numbers emerged, leaf numbers in the bud, stem length and shoot dry weight. The estimates in tables 1 and 2 are based on quadratic curves fitted to the logarithm of stem length or shoot dry weight on thermal time.

All experiments established well and initiated florets in the last week of October or in November. However, the shoot dry weights achieved by about 20 December differed greatly from about 2.5 g/plant in the sites with most growth (Edinburgh 1991 and 1992) to as little as 0.1 g/plant at Aberdeen in 1992.

TABLE 1. Heat unit accumulation for the six common cultivars from sowing to 200 mm stem length (Day degrees above 0^oC)

	Edin-burgh 1991	Edin-burgh 1992	Edin-burgh 1993	Aber-deen 1992	Aber-deen 1993	Mean
Cobra	1347	1525	1434	1730	1412	1490
Libravo	1318	1503	1383	1731	1381	1463
Falcon	1359	1552	1440	1705	1409	1493
Samourai	1282	1452	1411	1736	1391	1454
Envol	1296	1543	1354	1723	1370	1457
Rocket	1378	1546	1448	1739	1407	1504
Mean	1330	1520	1412	1727	1395	1477

In all experiments, the linear phase of stem extension began at a stem length of about 200 mm. In three of the experiments (Edinburgh 91 and 93, Aberdeen 93) the 200 mm length occurred after a mean of 1379 day degrees above 0^oC (table 1). However, in two sites stem growth was much delayed. In the extreme site at Aberdeen in 1992, a stem length of 200 mm was achieved only after 1727 day degrees and Envol and Samourai which were otherwise early extenders, failed to express that character.

TABLE 2. Shoot dry weight at the 200 mm stem length point (g/plant)

	Edin-burgh 1991	Edin-burgh 1992	Edin-burgh 1993	Aber-deen 1992	Aber-deen 1993	Mean
Cobra	4.75	5.34	4.18	3.63	4.20	4.42
Libravo	4.59	3.97	4.06	2.99	3.83	3.89
Falcon	4.18	4.21	3.90	3.79	4.27	4.07
Samourai	3.94	3.53	2.55	3.11	3.00	3.23
Envol	3.19	5.29	3.56	3.62	2.97	3.73
Rocket	4.73	4.73	4.31	4.03	3.92	4.34
Mean	4.23	4.51	3.76	3.53	3.70	3.95

The shoot dry weights at the time when stem length reached 200 mm length were remarkably constant for the different experiments (table 2).

Final stem length measured from ground level to the top node (excluding the terminal raceme) tended to be greater in the sites with earliest stem extension (table 3) but the regression of stem length on thermal time to 200 mm explained only 57% of the difference between experiments in stem length and was not statistically significant.

We believe that there is a dual trigger requirement for the linear phase of stem extension: the accumulation of 1280 to 1380 day deg from sowing and the accumulation of 3.2 to 4.4 grams of shoot dry weight per plant, both depending on cultivar. Crops which are vigorous during the winter tend to be limited by thermal time, have longer stems and are prone to lodging. Crops which are not vigorous or which are grazed by pigeons extend only when they have accumulated sufficient photosynthetic capital.

TABLE 3. Final stem length to the top node (mm)

	Edinburgh 1991	Edinburgh 1992	Edinburgh 1993	Aberdeen 1992	Aberdeen 1993	Mean
Cobra	1292	1198	1077	835	1108	1102
Libravo	1211	1273	1074	786	1061	1081
Falcon	1233	1159	1036	830	1054	1062
Samourai	1002	999	839	738	810	878
Envol	1157	1132	975	717	923	981
Rocket	1027	953	887	709	862	888
SED	31	48	50	48	42	
Mean	1154	1119	981	769	970	999

Winter vigour is difficult to predict. It is not a simple function of temperature. Grazing can be important in January and February but there remain unexplained differences in growth during November and December probably related to unquantified factors such as seedbed quality and soil aeration. We are having some success in modelling the dual limitation of thermal time and photosynthetic performance in controlling stem extension on a node by node basis in the spring but we have failed to simulate the processes of leaf development and dry matter accumulation in autumn and early winter.

REFERENCES

Fisher, N.M. and Walker, K.C (1992). Studies of development and stem extension in winter oilseed rape. *Proceedings, Second Congress of the European Society of Agronomy*, 68,69.