Improving establishment and early growth of spring turnip rape

Hannu Känkänen, Katri Pahkala, Elina Antinluoma, Pirjo Peltonen-Sainio
MTT Agrifood Research Finland, Plant Production Research, FIN-31600 Jokioinen, Finland.
Email hannu.kankanen@mtt.fi

ABSTRACT

Variation in yields of spring turnip rape (*Brassica rapa* L.) often arises from problems in establishment. A rapid and even emergence and early growth of the crop results in effective use of water and nutrients, and vigorous competition against weeds.

A project targeting to improve the vigour of seedlings of spring turnip rape bringing rapid growth and good soil cover was started in spring 2002. Germination of seeds and early growth of plants were stimulated by manipulating environment by adding soil moisture regulating hydroabsorbent polymers near the seeds at sowing and by seed coating with extenders or phosphorus. Direct drilling as a new sowing method was studied, too.

Polymers did not affect positively crop establishment, and a more precise method to place polyacrylamide near the seed is needed. Also the carrier technology has to be further improved for northern conditions. The effect of seed coating with phosphorus on plant biomass varied between cultivars and depending on time of measurement, which leads on to further studies to assess impact of seed quality on the effect of coating. Direct drilling assisted in saving soil moisture, and our further goal is to ensure that the extra water will be better used for crop growth.

Key words: Spring turnip rape – polymer - seed coating - direct drilling - establishment

INTRODUCTION

The yield of spring turnip rape (*Brassica rapa* L.) varies a lot in Finnish growing conditions. Poor emergence and early growth vigour often associates with low yield. Low plant density also weakens the competition against pests and weeds.

Polyacrylamides are used to improve water use both in agriculture and horticulture (Johnson and Veltkamp 1985), although in Finland only horticultural use is known so far. First experiences of polyacrylamides in order to enhance early growth of spring turnip rape was gathered in summer 2002. Similarly, seed coating for frost-seeding (Sparrow and Knight 1992) and for phosphorus supplement were studied, the former in no-till sowing and the latter in conventional sowing in ploughed and harrowed soil.

Direct drilling is increasingly used in cereal cultivation in Finland. Spring turnip rape often is in crop rotation at Finnish cereal farms. Hence, applicability of direct drilling for spring turnip rape is studied.

MATERIALS AND METHODS

The experiments were established in Jokioinen (60^{o}49’ N, 23^{o}28’ E) in 2002.

Two different *hydroabsorbent polyacrylamides* were sown in a mixture with the seeds at three different dates. The sowing was done in 29 April, 20 May and 31 May into moist, favorable and dry soil, respectively. The first sowing date was exceptionally early, the second close to long term mean and the third late one. Three amounts of polyacrylamides, 20, 50 and 100 % of the seed amount, were compared with control.

Effect of polyacrylamide was studied also in pot trial in moist and dry soil. Two soil types were used, sand and clay soil, the latter taken from the field trial. The amounts of polyacrylamide were 0, 100, 200 and 400 % of the seed amount.

Carrier technology was studied by sowing coated seeds on no-tilled soil surface in early spring 2002 when the soil surface was still frozen, and in late autumn 2002 when the soil surface was allready frozen. The former sowing was done with four replicates, the latter with no replicates. Three amounts of *imbibition inhibiting coating*, 3, 5 and 7 % of seed weight, were used in the spring and two amounts (4 and 6 %) in the following autumn. In autumn, 20 netting bags, each including 100 seeds, were placed in each plot. Half of the bags were covered slightly by straw, and all of them by a thin layer of light snow, which was on the field at that time. One straw-covered and no-covered bag from all plots was taken to germination test 3, 5 and 10 weeks later. The sampling procedure will be continued after completing this paper.

The effect of *seed coating with phosphorus* was studied with two cultivars, 'Kulta' and 'Valo'. Seeds were sown on 23 May, after harrowing and fertilizing the ploughed clay soil. Samples for measuring biomass of the plants were taken on 5 June, 18 June, 3 July and 27 August.

Direct drilling was compared with conventional sowing on ploughed sandy clay soil. Direct drilling was made before (24 April), at the same day (3 May) and later than (23 May) conventional sowing. Soil moisture in depths of 0-2.5, 2.5-5 and 5-7.5 cm and the number of plants were measured.

RESULTS

There was no difference in seedling number between the two *hydroabsorbent polyacrylamides*. The seedling number at first, second and third sowing was 170, 225 and 205 plant m^{-2}, respectively. No constant effect of the amount of polymer was recorded. However, in dry soil, the increase in the amount of polymer B2 tended to decrease the seedling emergence.

In the pot trial, only a slight delay of emergence with the highest polymer amount was found in dry clay soil, whereas in dry sandy soil, the polymer prevented germination (Figure 1).

Exceptionally early sown seeds coated with biogradable *imbibition inhibitor* did not germinate at high rate. According to first three samples taken from autumn sown seeds, germination inhibition caused by coating is however gradually lost in winter circumstances, with temperature under 0 ^{0}C (Figure 2). The change was even somewhat faster when seeds were covered by straw.

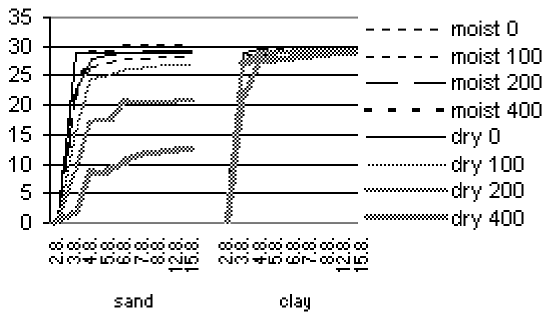

Fig. 1. Emergence of spring turnip rape in moist and dry sand and clay soil when polyacrylamide (0, 100, 200 and 400 % of seed amount) was sown with 30 seeds.

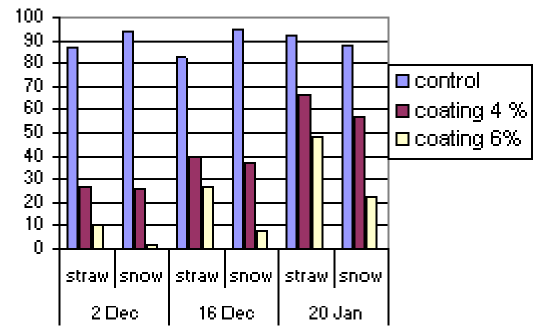

Fig. 2. Germination rate (%) of seeds coated with imbibition inhibitor sown on no-tilled soil under straw or snow and taken in room temperature 3, 5 and 10 weeks later.

Coating the seed *with phosphorus* slightly decreased plant biomass at early growth stages (Table 1). At harvest the seed coating treatment increased the plant biomass of cultivar 'Kulta', but decreased the biomass of cultivar 'Valo'.

Soil moisture at sowing in 0 – 5 cm layer was higher in *direct drilling* than in conventional sowing, even in the latest direct drilling time although precipitation was quite low between the sowing dates. Even then the number of plants clearly decreased when sowing was delayed. The number of plants were 130, 150, 80 and 50 plants m^{-2} with conventional sowing and early, middle and late direct drilling, respectively.

Table 1. Dry weight of plants in four growth stages with cultivars 'Kulta' and 'Valo' when seed coating with phosphorus and control was compared.

		Kulta		Valo	
	growth	dry weight, g/plant		dry weight, g/plant	
	stage	control	coating	control	coating
5 June	2,1	0,015	0,014	0,017	0,016
18 June	3,1	0,507	0,479	0,571	0,483
3 July	4,1	2,996	3,063	3,408	3,253
27 August	5,4	15,99	17,02	16,99	16,31

DISCUSSION

The seedling emergense was affected by sowing date rather than *hydroabsorbent polyacrylamides* used to stimulate germination. However, in a pot trial it was found, that when the soil is dry, polyacrylamide can even prevent germination. This was confirmed at the field in some cases in the latest sowing. Polyacrylamides are used for absorbing surplus of water to be transferred later to plants, when there otherwise would be lack of water (Johnson 1984). This was not the case in this study. The soil was not moist enough even in the first sowing date or after summer rains to store water for significant later use for plants that would have associated with increased biomass production. Moreover, field trial was done on typical Finnish clay soil, which do have better water storing capacity than sandy soils.

After very poor establishment of early spring sown seed coated with biogradable *imbibition inhibition* on no-tilled soil surface, more precise seed vigour observations were done when sown in late autumn. Germination inhibition seemed to be strong even in room temperature, but our preliminary results indicated that the inhibition is likely to weaken during winter. Samples that will be collected in spring and early summer will show, whether the inhibitive effect of the coating disappears early enough to result in good establishment of spring turnip rape crop in early summer.

According to the biomass measurements, the effect of seed *coating with phosphorus* varied between cultivars, but also depending on time of measurement. Although the coating affected slightly negatively the plant biomass at early growth, the effect turned to be positive later on with cultivar 'Kulta'. Instead, the effect of coating remained negative through the growth of cultivar 'Valo'. Thus, further studies are needed to understand the contrasting response of the cultivars studied.

Direct drilling clearly assists saving soil moisture as compared with conventional sowing. According to number of emerged plants, direct drilling needs higher soil moisture to provide even establishment. However, fertilizer placement in same row with the seed may restrict germination.

Until now, the methods developed to improve establishment of spring turnip rape are in process and new possibilities have been aroused. For example, more precise method to place lower concentrations of polyacrylamide near the seed is needed. Coating the seed with phosphorus will also be studied more closely. Forthcoming studies aims also at developing the direct drilling for spring turnip rape, so that good establishment is achieved.

REFERENCES

Harper, F.R. and B. Berkenkamp, 1975. Revised growth-stage key for Brassica campestris and B. Napus. Can. J. Plant Sci. 55, 657-658.

Johnson, M.S. 1984. The effects of gel-forming polyacrylamides on moisture storage in sandy soils. J. Sci. Food Agric. 35, 1196-1200.

Sparrow, S.D. and C.W. Knight, 1992. Frost-seeding of summer turnip rape in the subarctic. Can. J. Plant Sci. 72, 713-723.