Legume Seed Production & Research in Europe

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Within the member states of the European Union (EU), clover seed were produced on 25.422 hectare in 2000. Red clover (*Trifolium pratense* L.) seed production encounters 11.031 hectare, white clover (*Trifolium repens* L.) 4.346 hectare and other clover species 10.045 hectare (figure 1). The group 'other clovers' consists among others of Crimson clover (*Trifolium incarnatum* L.) and alsike clover (*Trifolium hybridum* L.). These species are predominantly grown in the southern parts of Europe. In 1991 red clover seed production area increased due to the re-union in Germany, however, in the following years it decreased. Since 1997 the area has increased steadily to a total in 2000 higher than in 1991. France has the largest production area of red clover (5.732 hectare) followed by the new EU member state, Sweden.

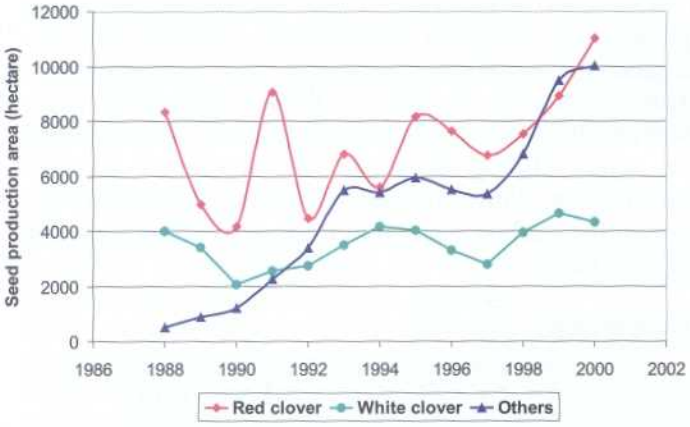

Figure 1. Total clover seed production area (hectare) in EU member states. The illustrated species are red clover (*Trifolium pratense* L.), white clover (*Trifolium repens* L.) and other clovers. Source the Danish Seed Council.

In Denmark 80% of the total EU white clover seed production is produced, however, the production area in New Zealand is approximately twice as big (8.000 hectare) even it has decreased by 9.000 hectare since 1993. Alfalfa (*Lotus sativa* L.) is not grown for seed production in the Northern European countries, whereas in France the production is increasing, and in 2000 the total alfalfa seed production area was 15.118 hectare (Sicard, 2001). Alfalfa is also grown for seed in Central European countries such as Hungary.
The most widely grown clover specie in Denmark is white clover whereas the Danish production of red clover accounts for less than 1% of the EU production. The production area of the two clover species is shown in figure 2. The average Danish seed yields in red clover and white clover are 485 and 483 kg hectare^{-1} respectively as a 10-year average.

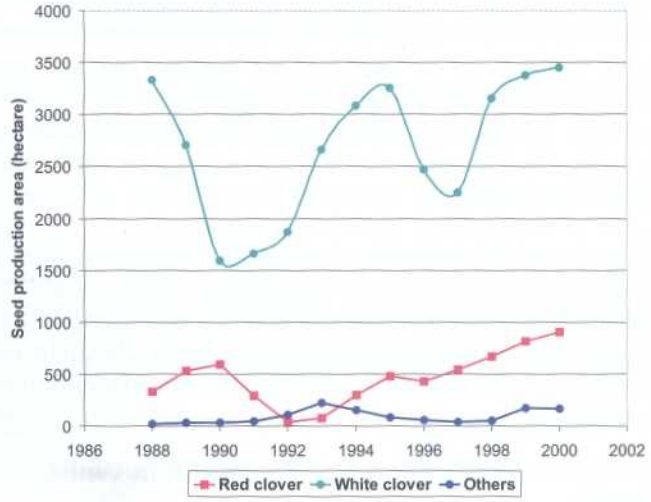

Figure 2. Clover seed production area (hectare) in Denmark. The illustrated species are red clover (*Trifolium pratense* L.), white clover (*Trifolium repens* L.) and other clovers. Source the Danish Seed Council.

European Production and Research in Red Clover

Red clover seed production in France is located in central France where summers are mild with average temperatures of 19°C. Red clover is sown in August either in a pure stand or in a cover crop (Bouet and Sicard, 1997). Defoliation is normally performed in spring of the seed production year in order to synchronise flowering with pollinator activities. The defoliated material is used for forage or it is finely chopped and left on the soil. Pests are controlled chemically and prior to harvest the crop is desiccated. Average seed yields are 700 kg hectare^{-1}.

In Denmark red clover is established in a spring barley cover crop, and clover is harvested only on 1-year stands. Establishment on 12 or 24 cm row distance does not influence seed yield. The vegetative development is often very vigorous and lodging can be observed before harvest. A spring cut seems to prevent lodging without reducing seed yield and without delaying harvest. The crop is either desiccated or swathed before harvest. In conventional production weeds can be controlled either in the establishment year, during winter or by mechanical weed control (harrowing) in the spring of the seed production year. In most fields pests are controlled by 1-2 sprayings.

In Sweden red clover is also established in a spring barley cover crop but in combination with meadow fescue (*Festuca pratense* Huds.). After red clover seed harvest the crop is removed by a herbicide and the following year meadow fescue seed is harvested.

Recently mixed cropping of red clover and timothy (*Phleum pratense* L.) for organic seed production has been tested in Norway in order to optimise timothy seed yields on farms with no access to manure (Aamlid, 1999). High yields of red clover were obtained in the first year after establishment, however, the red clover was found to suppress the timothy seed yield (in the second year after establishment) compared to a similar cropping system using white or alsike clover. These findings indicate that red clover is able to provide significant amounts of nitrogen for the successive crop. This is confirmed by ongoing Danish research where red clover is used as a green manure crop.

Recent research activities have also shown that mixed cropping of red clover and a forage grass species sown for seed production may produce high forage yields in the first year after establishment (Deleuran and Boelt, 2000). In the second year after establishment high grass seed yields may be obtained.

European Production and Research in White Clover

White clover is an important cover crop for Kentucky bluegrass (*Poa pratensis* L.) in Denmark. Spring barley, white clover and Kentucky bluegrass are spring sown and the successive harvests are as follows:

1. year - spring barley
2. year - white clover seed
3. year - Kentucky bluegrass
4. year - Kentucky bluegrass.

In Denmark this system is recognised as the most successful establishment method in Kentucky bluegrass.

White clover is sown at very low seeding rates, however, the white clover may establish so vigorous that especially amenity types of Kentucky bluegrass may be suppressed. Defoliation of the white clover in the seed production year when the first flower buds become visible is found to increase the subsequent Kentucky bluegrass seed yield.

As for red clover, white clover seed is harvested only on one year stands. Establishment is performed in spring barley at seeding rates between 1-3 kg hectare^{-1} in conventional farming systems and a row distance of 12 or 24 cm. Weeds are controlled in the spring barley cover crop or in winter prior to the seed harvest year. Pests (clover seed aphids) may cause serious yield reduction and in conventional farming they are controlled by 1-2 sprayings. The crop is swathed approximately 24 days after main-pollination, and it is of outmost importance that is it swathed and wind-drowed in dry conditions. The complete harvest yield may be lost if the crop is swathed and left in the field in wet and humid conditions.

Organic white clover seed production seems to be extremely difficult. Research to identify the main obstacles has been initiated and the preliminary results show that the white clover seed weevil reduces seed yield in the range of 10-60%. However, the obtained yields are only 20-30% of the normally obtained yield in conventional production. Seed yield, yield components and clover seed weevil intensity are monitored in organic farmers fields to identify yield reducing factors and possibly to suggest management strategies to improve yields. White clover seed production is tested in trials in France at the moment.

European Production and Research in Alfalfa

Alfalfa is an important crop seed crop in France (15.118 hectare). In the western part of France it is often established undersown in sunflower (*Helianthus annuus* L.), and alfalfa seed is harvested in 1-2 years after establishment (Bouchet, 1990). A forage cut is taken in spring in order to synchronise the reproductive development with pollinator activity. It is summarized that seed yield is strongly correlated with seeds per pod, and with raceme and pod number (Hacquet, 1990). These yield components are optimised by the correct management with respect to row spacing, time of defoliation and irrigation. Increasing temperatures in the interval 20-26°C during anthesis increase seed yield, whereas high rainfall (>100mm) during anthesis reduce seed yield.

In the years 1974-1984 experiments were carried out to determine seed yield in alfalfa cultivars and to test different cultivation techniques (Nordestgaard, 1978, 1985). Yields in the range of 840 - 1080 kg hectare^{-1} were obtained on average of three experimental years and five locations. Germination percentage was between 90-93. However, in some trials seed yield failed more or less and it was concluded that moderate to high seed yields depended on successful pollination and moderate to low precipitation during flowering. At present alfalfa is not grown for seed production in Denmark except for a few organic fields.

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