

Considerations in *Lotus* spp. seed production

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Of the about 100 species that we know of *Lotus*, only three species are used extensively in the worldwide farming.

Lotus corniculatus L. (broadleaf trefoil)

Lotus tenuis Waldst. & Kit. (narrowleaf trefoil)

Lotus uliginosus Schk. (big trefoil)

There is a great breach between the potential seed yield and the average yield got by the farm producers (Seaney and Henson, 1970). It is due to the fact that they are species of indeterminate flowering, high dehiscence of the sheath, low survival of the stand of the plant, and mainly to the variety of ambient of production, genetic differences of the materials used and the practical difficulties in the management of farming that make it difficult to give generalizations and standard recommendations to the management of paddocks (Fairey, 1994; Fairey and Smith, 1999; Artola, 2004).

L. corniculatus is the species most spread and the most studied, in which diverse investigations in the production of seed have been done: components of yield (Albrechtsen *et al.*, 1966; Li and Hill, 1989), potentials of yield (Sareen, 2004), pollination (Morse, 1958; Peterson, 1991), effect of the spatial distribution of the plants (McGraw and Beuselinck, 1987; McGraw *et al.*, 1986); the process of ripeness of the seeds (Pieroni, 1994; Anderson, 1955). Some investigations were made in *L. uliginosus* which study the density and spaciousness suitable for seed production (Hare, 1984; Hare and Lucas, 1984), and the use of regulators of growth (Tabora and Hill, 1992), the use of weedkillers to control weeds (Tabora and Hill, 1992) have been done, too. On the other hand, in *Lotus tenuis*, the investigations in seed production have been from limited to nonexistent.

The potential seed yield estimated in *Lotus* is 1200 kg/ ha, the average yields got to a worldwide level are below 200 kg/ha. In the USA, the average yields are between 50 and 170 kg/ha (Fairey and Smith, 1999), in Uruguay the average yields are between 120 and 150 kg/ha (Garcia *et al.*, 1991; Artola, 2004); and in our country the average yields are between 25 and 150 kg/ ha (Mazzanti *et al.*, 1988).

They are species of long days that require a photoperiod of about 16 hours to complete the floral induction (Grant and Marten, 1985). These conditions take place in the North and South of the 40° latitude. Short days are harmful for the blossoming, resulting in poor production and bad quality of seed (McGraw *et al.*, 1986). It is in this way that the zones of major worldwide production are in the North and centre of the USA, South and centre of

Canada, New Zealand, Central Europe and South America. In our region, it takes place mainly in Uruguay, Argentina and Brazil. In Argentina, the zone of production is concentrated in the province of Entre Rios and Buenos Aires.

It happens the same with other species of leguminous, the success in the production of seed takes place due to the constant monitoring of the farming throughout the growing season, it is due mainly to the fact that the practice of the production of seed is mainly a handmade process, where it is very difficult to give generalizations and techniques of standard managements, due to the variety of situations of the ground, climate, latitude in which the seeds are produced and to the intrinsic characteristics of the species which we deal with. Basically, to increase or decrease the breach between the potential and the yield done, to be able to pass from 17- 20%, what is got nowadays, to 40%, equivalent to almost 500 kg/ ha, it must be taken into account a series of factors that bring techniques of managements together or procedures that maximize the yield of farming. To summarize, what it is looked for is to achieve farming free of weeds with a suitable quantity of inflorescence/m² in the same phenologic state and to achieve a point of ripeness the most homogenous as possible to be able to decide the right time of farming and to get the major quantity of seed of the maximum quality.

These techniques and procedures consist of achieving to beat certain limitations that farming presents:

- 1) Implantation of farming: *Lotus* are species of low initial implantation (Nelson *et al.*, 1994) that is why they require a suitable sown land to get a developed farming, free of weeds. Factors to take into account:
 - Selection of the paddock and its predecessor (coverage, weeds and polluters)
 - Suitable sowing time (the earliest as possible to get an implanted and developed farming at the begging of the winter)
 - Density of sowing, suitable to get a stand of plants that provides us with the quantity of floral shoot required (4- 5 kg/ha)
 - Control of weeds. By the application of specific chemicals.
- 2) Reproductive development: they are species of long days and present a period of blossoming and seed formation very lengthy. It has been determined that the number of inflorescence/m² is the component of major influence in the production of seed (McGraw *et al.*, 1986). Due to the fact that the number of inflorescence is determined by the number of shoots, the suitable management of this component achieves the major uniformity of farming. Through the date of the closing of farming it can be managed the number and age of the reproductive shoots; it is achieved with cut or grassing. It has been determined that the optimum date of closing takes place in October/ November. Dates of early closing produce an excess of fodder that competes with the reproductive shoots and mechanic obstacles at the moment of the harvest; while the late closings go to the detriment of the yield to eliminate floral shoots that contribute to the final yield.
- 3) Pollination: the presence of pollinators is fundamental to get high yields. It is considered that 12 to 15 visits per flower are required to get a maximum of seed set (Morse, 1958). It is recommended two beehives/ ha (50.000 bees/ha) to a level of commercials lots to get suitable yields (Crane and Walter, 1984).

- 4) Harvest: There is a very wide breach between the theoretical potential of yield and the harvested in practices, against what it is obtained in the field. (Fairey and Smith, 1999). The average of yield got is between 100 and 350 kg/ha (Li and Hill, 1989). We can consider which losses between 60- 90 % of the potential can be observed in a frequent way during this period, in a most obvious way when we do not govern the different variables involved.

Aspects to take into account:

- Definition of the most suitable moment of the harvest (70- 80 % of ripe sheath (Fairey and Smith, 1999)
- Techniques of cut and/ or dried. The method most commonly used is the cut in row and then the harvest. Another technique is the dried, drying agent is applied, and direct harvest or a combination of dried – cut in row to harvest the farming later (Fairey and Smith, 1999)
- Effectiveness of the harvest. The time that goes on between the cut or dried of the farming to the harvest must allow the minor loss produced by thresh and get a seed of high quality with low level of humidity.
- Upgrading of the seed harvested: The conditions of humidity in which the seed is stored must be the ideal to avoid over heating In some cases, the seeds can be harvested with 18- 22 % of humidity, these levels of humidity are very high for the storage of the seed; that is why, in these cases the seed must be dried by a specific dryer or by spreading the material in the ground. The conditions of the seed storage must be areas with fresh conditions, dry and clean, to maintain the purity and germination.

FINAL CONSIDERATIONS

To summarize, to get the maximum potential of seed yield, we must:

- Understand and accept the complexity of the crop.
- Revise and implement practices that maximize the components and factors of yield.
- Understand that the major challenge of this farming is the management and adjustment of the harvest techniques.

To go on learning about some crucial aspects for the success in the production of the seeds for farming, the field investigation should be directed to:

- Spatial disposition of the number of optimum plants that maximizes the development (distance and density of sowing)
- Control of weeds, suitable weedkillers for different situations of weeds.
- Closing of lots, optimum moment of cut or closing of the lot defined by the zone of production.
- Control of vegetative growth.
- Suitable parameter to define the optimum moment of the harvest.

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