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# Status of *Orobanche crenata* in faba bean in the Mediterranean region and its control

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SUMMARY - *Orobanche crenata* is a parasitic weed infesting the Mediterranean region and Middle East. Field orientation, crop rotation, irrigation, fertilization, variety and sowing date affect *Orobanche* infestation. Different control methods have been established although most of them are either not fully effective or very expensive. The use of herbicide glyphosate has proven to be a practical method; the necessary number of applications for an effective control depend on the environmental conditions.

*RESUME - "Situation actuelle et contrôle de* Orobanche crenata *dans la culture de fève dans la région méditerranéenne". L'*Orobanche crenata *est une mauvaise herbe parasite qui infeste la région méditerranéenne et le Moyen-Orient. L'orientation des parcelles, la rotation des cultures, l'irrigation, la fertilisation, la variété et la date de semis sont des facteurs qui affectent l'infestation par* Orobanche. *Différentes méthodes de contrôle ont été établies, mais la plupart d'entre elles ne sont pas totalement efficaces ou sont très chères. Les traitements avec l'herbicide glyphosate se sont avérés opérants, et il semble que ce sont les conditions environnementales qui déterminent le nombre nécessaire d'applications pour obtenir un contrôle efficace.*

## Distribution and incidence

Broomrape is a parasitic weed found throughout the Mediterranean region and the Middle East. Information on its general distribution and incidence have been reported by Kuijt (1969); specific reports have been given by Schmitt (1978) in Morocco, Mesa-García *et al.* (1984b) in Andalucía (Southern Spain) and Sauerborn and Saxena (1987) in Syria. In a representative study of the 78% of the cultivated area of Morocco, *O. crenata* was present in 78% of the fields studied, completely destroying yield in 2% of the fields. In Andalucía, Southern Spain, *O. crenata* was present in 85% of the fields, causing serious infestations (at least 1 to 2 broomrapes per plant) in about 20% of them. Annual loss in yield was calculated at the regional level at approximately 1 million U.S. dollars. However, the most damaging impact of *O. crenata* has been that farmers delay the inclusion of faba bean in their rotation in order to avoid the appearance of *Orobanche*, thus limiting the area of this crop. In Syria, *O. crenata* was present in 71% of the fields in the North East region of Aleppo. ICARDA (1985) has reported a yield loss of 5-24% in faba bean because of *O. crenata*. In Egypt, Kadry *et al.* (1959) reported 33% in yield loss, whereas in Turkey this figure ranged from 30-70% (Moiseeva *et al.*, 1969).

In a competition study, Mesa-García and García-Torres (1984) established an equation between emerged *Orobanche* (ON) and percent yield loss (L) as:

$$L = 100 \times 0.124 \times ON$$

According to this equation, presence of, on an average, 4 broomrapes per faba bean reduced yield by half.

## Factors affecting incidence

In the survey by Mesa-García *et al.* (1984b), the results showed that short time intervals between successive crops, southern orientation of the field and no irrigation increase the severity of infestations. Plant spacing, simazine application, cultivar and P fertilization did not markedly affect occurrence and severity of infestations. We describe below these different elements:

– Field orientation: Higher temperatures in southern oriented fields produce major infestations. This is in agreement with the results obtained by Kasasian

(1973a) who studied the effect of temperature on germination and development of *O. crenata.*

- Frequency of susceptible crop in rotation: It is obvious that frequent inclusion of crops that permit *Orobanche* development, and thus high seed production, cause major infestations (Mesa-García *et al.,* 1986).
- Irrigation: Under dry conditions parasitic development with respect to the crop is favoured (Musselman, 1980). Moreover, under irrigation in the summer months, high temperatures and moisture can induce seed degradation.
- Fertilization: High N rates reduced the parasitism of *O. crenata* infestations under *in vitro* conditions (Kasasian, 1973b). However, under field conditions with different cultivars P fertilization was not a determinant factor of *O. crenata* infestations (Mesa-García *et al.,* 1984a).
- Variations in resistance or tolerance of faba bean to *O. crenata* exist (Cubero, 1986). However, introduction of genetic resistance to broomrape in commercial faba bean cultivars has not been very successful.
- Sowing date: Advancing of the sowing date increases infestations (Nassib and Hussein, 1984; Kukula and Masri, 1985; Mesa-García and García-Torres, 1986; Hezewijk *et al.,* 1987). This may be due to the longer period of *Orobanche* attachment and more root volume in the earlier sowings.

## Host-parasite relationships

Seeds germination conditions of *O. crenata* have been reported by Kasasian (1973a). After 11 days of moisture pretreatment at 18 °C, a higher germination percentage of *Orobanche* seeds occurred at 18-23 °C.

Attachment seems to be affected by the development of the host. Schmitt *et al.* (1979) in Morocco reported the coincidence between attachment and flowering. Mesa-García and García-Torres (1986) reported that attachment can coincide with flowering in the latest planting dates but not in the earlier ones where it can coincide with the vegetative development of the crop, especially in mild winters, suggesting that the *Orobanche* attachment-crop phenology interaction is affected by environmental conditions. Because of this interaction there is a need for adopting different postermergence applications to control *Orobanche* in different countries. When *O. crenata* is through stages 'd' (well developed shoot bud and roots) and 'e' (shoot bud elongated but still subterranean) competition between the parasite and host starts. Hence postermergence applications should be carried out before these stages are reached.

## Control

Different methods have been used to control *O. crenata.* Crop rotations with an infrequent presence of susceptible crops have been recommended to reduce *Orobanche* infestations. However, this method reduces the number of legume crops, which are of particular interest in the Mediterranean region.

Delays in the sowing date are useful to reduce the effects of the parasitic weed. However, they do not avoid the infestations. On the other hand, earlier sowing dates are of interest in order to achieve higher yield (Sauerborn and Saxena, 1986).

Introduction of resistance to *Orobanche* in commercial cultivars is desirable. Progress in this direction has so far been rather limited.

Derivative compounds of strigol induce *Orobanche* seed germination (Johnson *et al.,* 1976). These compounds are capable of controlling the parasite when applied to non-susceptible crops. Saghir (1986) however reported that before these compounds could be put to commercial use more research was needed with respect to application methods, time interval between application of the stimulant and sowing of a susceptible crop, and rates to be used on soils with differences in texture and pH.

The use of soil sterilants is effective in the control of the parasitic weed (Piglionica, 1973). Jacobson (1986) reported the use of ethyl bromide, ethylene dibromide and vapam. However, because of the high cost of these treatments, their use is restricted to high value crops in very limited areas.

The use of plastic to sterilize the soil has also been effective (Jacobson *et al.,* 1980) but has similar limitations as the use of chemical soil sterilants.

Irrigation under summer conditions is effective in reducing the infestation, but *Orobanche* infestation is generaly very high in dryland.

The use of 'catch crops', the crops with the ability to make *Orobanche* seeds germinate but not to permit their development, can reduce the number of *Orobanche* seeds in the soil. Ibrahim *et al.* (1973) reported a 32.6% germination of *O. crenata* seeds with flax.

Many herbicides have been assayed. Most of them were phytotoxic or not effective in the control of the parasite. Propizamide (Zahran *et al.,* 1980) and glyphosate (Kasasian, 1973b) have proven to be effective in the control of *Orobanche.* However, the former was effective at rates too high to be economically useful in extensive crops. Other herbicides like imazapyr, imazethapyr, chlortoluron also seem to be quite promising (García-Torres *et al.,* 1989).

Glyphosate is now commercially used in the control of *O. crenata* in faba bean. Kasasian (1973b) was the first one to report its efficacy. Mesa-García *et al.* (1984a) have studied its tolerance. In Morocco, work conducted by Schmidt *et al.* (1978) showed that a first application of 120 g a.i./ha with *Orobanche* in the tubercle stage and a second application at 60 g a.i./ha at the bud stage or two applications at 60 g a.i./ha with the *Orobanche* in the tubercle stage are effective. In Israel, Jacobson and Kelman (1980) obtained a high control with two applications. However, from their results it is possible to infer that even a high control of *Orobanche* is not enough to preserve a part of faba bean yield, probably due to the occurrence of a marked competition in the subterranean phase, or due to herbicide toxicity. In Egypt, Zahran *et al.* (1980) pointed out that 3 applications were necessary to obtain a satisfactory control of the parasite. Niccolis and Bianco (1986) in Italy have reported a high control with only one application. In Spain, Mesa-García and García-Torres (1985) have shown that one application in the 'shoot bud already visible' stage was enough to control *Orobanche* sown in the later dates. With severe infestations and earlier sowing dates, 2-3 applications were needed. With severe infestations a second application is necessary. In the earlier sowing dates the parasitic cycle is longer, thus a higher number of applications are necessary for its control. Climatic conditions affect the development cycle of the parasite, which can explain the need of the diverse number of applications to control the parasite in different regions.

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