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SEED HARDENESS IN GRAIN LEGUMES

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SUMMARY : *Impermeable testae or hard seededness are regarded as one of the leading causes of seed dormancy in grain legumes. Genetic and environment fators affect the degree of hard seededness which is a problem in wild species and only lasts for about three weeks in cultivated species. Hard seededness creates the problem of uneven germination and maturity, weed problem for subsequent crop and poor cookability. However, this character may be advantageous for the survival of wild species. Furthermore, semi-permeable or delayed permeable seeds that hold the initial uptake of water have a superior resistance against environmental hazards and show high vigour. This characters could have an important use in enhancing seed quality and viability in grain legume species.*

TANE BAKLAGİLLERDE SERT TOHUMLULUK

ÖZET : *Dane baklagil bitkilerinde sert tohumluluk dormansinin önemli sebeplerinden birisini teşkil etmektedir. Genetik ve çevre faktörleri sert tohumluluk oranını etkilemektedir. Sert tohumluluk yabani formlarda sık olarak görülmekte ve kültür formlarında ise hasattan 2-3 hafta sonra kaybolmaktadır.*

Sert tohumluluk, düzensiz çimlenme ve olgunlaşma, bir sonraki ürün için yabancı ot problemi ve zayıf pişme özelliği gibi problemlere yol açmaktadır. Fakat bu karakter yabani türlerin neslinin devamı ve tarlada olgunlaşmayı müteakip erken çimlenmeyi önlemek açısından önemlidir. Yarı-sert tohumluluk ya da su alımını bir süre geciktirme özelliğine sahip varyeteler ise olumsuz çevre şartlarına dayanıklılık göstermekte olup yüksek tohum kalitesine sahiptirler. Dolayısıyla bu karakter dane baklagillerde karşılaşılan tohumun canlılığının kaybolması veya kalitesinin düşmesi gibi problemleri gidermek amacıyla kullanılabilir.

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INTRODUCTION

Hard seededness due to impermeable seed coats is one of the leading causes of seed dormancy that has implications for the husbandry of grain legumes. Hard seeds present uneven germination problems and poor cokability. However, recent evidence shows that legume cultivars with semi-permeable testae are resistant to environmental conditions during storage and transport and have superior quality. This review criticizes the literature on testa induced dormancy and its future potential.

Hard Seededness

Seeds that have water-impermeable testae prevent the entry of water into seed and remain hard to the touch even when appropriate moisture and temperature conditions are provided. Therefore, such seeds do not germinate unless the seed coat is scarified. The presence of a hard and impermeable seed coat is regarded as a widespread cause of seed dormancy in the grain legume species (Villier, 1972; Donnetlly et al. 1972; Ladisky, 1985; Jha and Sinha, 1989) as well as other legume species (Taylor and Palmer, 1979; Egley, 1989). Seeds that remain hard and ungerminated for 15 days are considered dormant depending on the species (ISTA, 1985; Khare and Singh, 1984). Hard testa induced dormancy exists in grain legumes, namely in lentils (Bagoury, 1974; Ladinsky, 1985), faba beans (Jha and Sinha, 1989), Soybeans (harris, 1987), peas (Werker et al. 1979), phaseolus beans (White and Izquierdo, 1991) and cowpeas (Lush et al., 1980). But, in seeds of most of the cultivated species hard seed dormancy lasts only for up to three or four weeks depending on genotypes (Saxena and Hawtin, 1981). Therefore, this poses seldom a constraint in their production although seeds of their wild species remain dormant for months even for years.

Underlying reasons for hard seededness

This type of dormancy is controlled by genetic (Donnely et at., 1972; Rolston, 1978; Khare and Singh, 1984; Ladisky, 1985) and environmental (Nakamura, 1961; Quinlivan, 1971; Taylor and Plamer, 1979; Egley, 1989) factors. A single dominant gene controls hard seededness in blue lupin (Lupinus angustifolius) (Forbes and Wells, 1968), a single dominant gene in lentils (Lens culinaris) (Ladisky, 1985) and two or more genes in common beans (Phaseolus vulgaris) (Dickson and Boetger, 1982).

Various features of outer palisade layer of the testa are related to impermeability to water of seed coat in legume species. A thick cuticle (Khudairi,

1956), the continuous pectinaceous layer of the caps of the palisade cells and the presence of quinone (Werker et al., 1979), the light line which extends across the upper portion of the seed coat (Ballard, 1973), oxidation of phenolics during maturation (Marbach and Mayer, 1974), tightly packed cells (Werker, 1981), and tight adherence of the testa to underlying tissues (Powell, 1989) and the lack of pores, the phenolic layer and the cutin in hilum region (Harris, 1987) have been cited in various works as causes of water impermeability or barriers to uptake of water. Cultivars that have impermeable seed coats have a thick testae (Nooden et al., 1985; Egley, 1989). Impermeability or low water absorbtion in soya beans is, however, related to a high density of waxy material embedded in the epidermis (Calero et al., 1981; Yaklich et al., 1985). Drought (Nooden et al., 1985) and the water and nutrient status of the mother plant (Egley, 1989) also affect water impermeability.

Permeability of testa can be restored by incision or scrification of the testa (Jha and Sinha, 1989), by soaking seeds in concentrated sulphuric acid (Rolston, 1978; Jha and Sinha, 1989), hot water treatment and chemical treatment of seeds (Hanna, 1984; Pritchard et al., 1988) and enzyme application to seeds (Egley, 1989).

Agricultural Implications

Seed hardeness presents obstacles for the evaluation of seed performance and germination in germination tests (Roberts and Black, 1989) and results in volunteer plants in the field that can cause seed mixtures and weed problem (Muehlbauver and Slinkard, 1981) for sussequent crop. It creates problems at harvest because of uneven ripening. Such cultivars have also poor cookability (Powrie et al., 1960; Youssef and Bushuk, 1984). However, it may also be advantageous for the survival of wild species. Hard-seededness reduces summer germination when conditions are not favourable for germination and provides as a seed reserve for years following stand failure (Quinlivan, 1971).

Some water impermeability. i.e. semi-impermeability, may also be beneficial for maintaining vigour of seed during storage, particularly under conditions of high humidity (Potts et a., 1978). Hard seeded cultivars better resist weathering in the field (Literatures in Kuo, 1989). Seeds of cultivars that have slow water absorbtion characteristics (delayed fermeability), i.e.. seeds which are not completely hard, but whose imbibition is initially delayed, are resistant to cycles of wetting and drying prior to harvest, and absorb moisture more slowly from the ambient atmosphere during open storage (Kuo, 1989; Hampton, 1991).

Therefore, such seeds are more likely to be able to withstand environmental

hazards while in transit, particularly fluctuaion in temperature and humidity in containers within in a ship's hold for export and moisture fluctuations in storage (Hampton, 1991). Rapid water uptake led to poor field emergence in grain legumes (Powell et al., 1984). Cultivars with thin testa have higher rates of water uptake and poor vigour in peas (Powell, 1989), lima beans (Kannenberg and Allard, 1964), phaseolus beans (Wyatt, 1977), sobeans (Kuo, 1989) and chickpeas (Knights and Mailer, 1989). Since the seed coat is considered as a barrier to diffusion of water and gases, selection consciously for varieties resistant to water uptake from atmosphere has been suggested in order to enhance seed viability and vigour (Hinson and Hartwig, 1977; Kuo, 1989; Powell, 1989; Hampton, 1991).

Future potential

Cultivars with a delayed-permeable testa have been already recognised in peas (Powell, 1989), soybean (Kuo, 1989), faba beans (Kantar, 1992) and in mung beans (Kuo and Tarn, 1987). There is a need for more specific selection for such seeds that would start imbibition one hour after soaking when enhanced seed vigour is a primary objective (Hampton, 1991). This is relatively simple procedure on basis of electrical conductivity and water absorbtion rates (Kuo, 1989). Screening of the legume seed collection that Faculty of Agriculture possesses in Erzurum for this purposes may identify such accessions that can be used as a genetic material for future programs.

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