HERBICIDE RESISTANCE AND POPULATION PROCESSES IN BLACKGRASS

P.F. Ulf-Hansen, A.M. Mortimer and P.D. Putwain
Department of Botany, University of Liverpool, PO Box 147
Liverpool L69 3BX U.K.

Abstract. Modern chemical weed control practices exert intense selection pressures on weed species and may result in the evolution of herbicide-resistant weeds. Little is known about the factors which influence the rate of spread of resistance, even though it can be very rapid. Important factors include the genetic basis of resistance, the intensity and duration of selection pressures, and the relative ecological fitness of resistant and susceptible plants. Results are presented from a field experiment investigating the effect of herbicide treatment on a range of densities of resistant (R) and susceptible (S) biotypes of blackgrass, *Alopecurus myosuroides* Huds. in wheat. The work focuses on a comparative analysis of components of fitness of biotypes, survivorship and seed production and on population dynamics.

The experiment was conducted in 1985/86 on a sandy-loam soil in Cheshire, U.K. Seed from herbicide resistant and susceptible populations of blackgrass was sown as monocultures at six densities: 1, 10, 30, 100, 300, 1000 seed m^{-2}. Chlorotoluron was applied at 0, 1.38 and 2.75 kg a.i./ha in the spring of 1986. Emergence and death of blackgrass plants were monitored at 2-3 week intervals until harvest in late summer 1986, when seed production of individual plants was measured. The plots were either 0.25 or 1 m^2.

The 1.38 and 2.75 kg/ha rates of chlorotoluron killed 67% and 84%, respectively, of the S biotype, but only 13% and 16% of the R biotype. For all plants, of either biotype, there was little evidence of density-dependent mortality, irrespective of time of emergence. However, seedlings showed differences in survival according to age, with early emergence favouring longer life-span. Herbicide treatment reduced seed production in blackgrass by 85 and 90% at 1.38 and 2.75 kg/ha of chlorotoluron for the S biotype. For the R biotype, the equivalent reductions were 36 and 56%, respectively.

In the absence of chlorotoluron the effects of density on seed production were noticeable, though the biotypes did not differ in response. At low densities plants produced about 800 seeds $plant^{-1}$, whilst at the highest density 100-200 seeds $plant^{-1}$ were produced. In the presence of herbicide, however, seed production of either biotype became independent of density. Plant densities were not high enough to result in seed yield m^{-2} becoming independent of sowing density. In the absence of chlorotoluron the response of seed yield to density of the two biotypes did not differ over the density range examined. The seed yield m^{-2} increased with density in the resistant population under both rates of chlorotoluron but only at 1.38 kg/ha for the susceptible population.

The experiment confirms that the intensity of selection for resistant phenotypes is high. Chlorotoluron reduced surviving plants so that density-dependent regulation was not seen in terms of either seed production or plant mortality. Plants did not compensate, however, for low density by increased seed yield because of herbicide treatment and intense crop competition. In the absence of chlorotoluron the ecological fitness of the two biotypes as measured by surviving plants and seed production in the field were essentially similar.