

**The biology and non-chemical control of common couch**  
**(*Elytrigia repens* (L.) Nevski)**

**W Bond & RJ Turner**

HDRA, Ryton Organic Gardens, Coventry, CV8 3LG, UK

***Elytrigia repens* (L.) Nevski**

(*Agropyron repens* (L.) Beauv.; *Elymus repens* (L.) Gould; *Triticum repens* L.)

**Common Couch**

(couch, couchgrass, quackgrass, quicks, scutch, squitch, twitch, wickens, wicks)

**Occurrence**

Reviews of common couch have been made by Palmer & Sagar (1963), Holm *et al.* (1977), Werner & Rioux (1977) and Boyall *et al.* (1981). Common couch is a native of Europe and is found throughout the British Isles on cultivated, waste and rough ground (Clapham *et al.*, 1987; Stace, 1997). In a survey of conventional cereal crops in central southern England in 1982 the most frequent grass weed was couch which was found in 42% of winter wheat, 14% of winter barley and 31% of spring barley fields (Chancellor & Froud-Williams, 1984). It occurs on both heavy and light soils (Brenchley 1911; 1913), but is able to spread more readily on lighter land (Salisbury, 1962). It is rarely present in good old pastures and meadows but is found in most hedgerows (Long, 1938). It rapidly spreads out from the field margins into cultivated fields.

It can form dense stands that exclude other vegetation (Weber, 2003). It thrives in cooler climates and is one of the most serious weeds in the Northern temperate zone but is absent from the tropics (Palmer & Sagar, 1963). As a C<sub>3</sub> plant, in terms of photosynthetic pathways, couch is not well adapted to hot dry climates (Håkansson, 2003). At higher temperatures biomass production is lowered and the allocation of photosynthates to underground organs decreases. Rhizome production is reduced, limiting the plants invasiveness. In South America and other warm countries, it may grow in cooler mountain regions (Holm *et al.*, 1977). The aerial shoots do not appear to be harmed by freezing but a few days exposure to frost will kill rhizomes left on the soil surface (Håkansson, 2003).

Common couch prefers heavier soils but grows on most soil types except those with a low pH. In compacted soil, the rhizomes grow more or less horizontally. In undisturbed arable land a mat of young rhizomes is found in the top 10 cm of soil at the end of the growing season. In uncultivated land with a layer of deep litter the rhizomes may grow above the soil surface under the litter. In pasture, couch has short rhizomes and apical dominance maintains buds in a dormant state. In loose soils the rhizomes grow down at an angle of 5-10° to the horizontal and may reach depths of 40 cm (Palmer & Sagar, 1963).

Couch growth is especially vigorous on fallow land and in the first years after tillage ceases (Werner & Rioux, 1977). It may make up to 90% of the biomass in an abandoned field for several years preventing colonization by dicotyledonous species. Couch is sensitive to shading, however, and when scrub take over the grass gradually dies out. Old permanent pastures tend to have little couch present (Long, 1938).

Nevertheless, Peel and Hopkins (1980) found that infestations were as common in swards over 20 years old as on recently sown swards. In a survey of 502 grassland farms couch was found to affect 1% of all fields but was more common in eastern England where 10% of fields were infested with it. It was recorded more often on dairy farms than beef farms.

In the north of England, the later and more protracted ripening of cereals favours couch and other rhizomatous grasses (Attwood, 1981). There is a long period after the cereal leaves dieback and before harvest when the canopy opens and couch can make good growth and build up reserves. After the later harvest there is usually only a short period for cultivations before the land becomes too wet to work.

Couch and other grasses are alternative hosts for the frit fly and gout fly (Morse & Palmer, 1925).

### **Biology**

Aerial shoots may initiate flowers during April or early May that develop in May, June or July. Couch requires a minimum temperature of 23 °C for flowering. The flowering period extends from June to September (MAFF, 1974, Clapham *et al.*, 1987). Couch is self-sterile and a large patch may consist of a single clone but as the flowers are wind pollinated, fertilisation is not necessarily a problem (Werner & Rioux, 1977). Varietal names have been given to several recognised forms or clones (Palmer & Sagar, 1963).

The seed heads mature during August and September at around the time of cereal harvest. Many seeds are viable when green and immature (Williams, 1971). Around 20% of the final number of viable seeds was viable 10-18 days after flowering depending on prevailing conditions. Viable seeds were found in around 95% of spikes of couch collected shortly before harvest from a range of crops, predominantly cereals (Williams & Attwood, 1971). Plants may produce up to 400 seeds per stem but 25-40 is more usual of which on average 13 are viable. Seed samples collected within 3 weeks of the assumed flowering date showed much less germination than those collected later. The percentage germination increased the later the date of sampling, a 1% increase for each days delay after 15<sup>th</sup> July.

The seed does not require an after-ripening period and could germinate anytime after shedding if conditions are right. Light is of little importance, but fresh seed requires the temperature to alternate between 15 and 25 °C for germination to occur. Seed will not germinate under constant temperatures (Palmer & Sagar, 1963). The seeds germinate mainly during autumn in the UK but germination may be delayed by cold temperatures, inadequate moisture or deep burial (Williams, 1971). Seed buried at 5 cm deep all germinated and emerged but only 4% of seed buried at 10 cm deep emerged and none from 12.5 or 15 cm. Once buried in soil, seed can lie dormant for 2-3 years and remains viable for about 4 years. In Duvel's seed burial experiment 19% of seeds buried at 42 inches were remained viable after 4 years but only 1% at 22 and none at 8 inches deep (Toole & Browne, 1946). After 10 years, 2% of seeds were still viable at 42 inches deep but none at the shallower depths, and none remained alive at any depth after 16 years.

According to Werner & Rioux (1977), germination normally occurs in early spring which is true in many countries including Sweden and Russia. The seedlings begin to tiller at the 4-6 leaf stage and produce rhizomes at the 6-8 leaf stage. Håkansson (1970a), however, found that seedlings began to develop rhizomes at the 4-5 leaf stage in mid- to late-June. Subsequent development of plants from seed was similar to that of plants growing from rhizome pieces (Håkansson, 1967). The young seedlings are unable to regenerate vegetatively until rhizomes several centimetres long have developed. Large variations occur in the growth and morphology of seedlings from seeds collected in different areas even when grown under relatively uniform conditions (Williams, 1973a). Variations between seedlings and clones in the number of shoots per plant were very great. It was noted that plants with the least shoot weight had the most rhizomes.

Vegetative reproduction in couch is far more important than from seed. Rhizome growth is renewed annually from axillary buds that develop in the crown tissue at the base of the aerial shoots, and in the transition zone between shoot and rhizome (Håkansson, 1982). Rhizomes grow horizontally in summer before turning erect in autumn ready to form a primary aerial shoot. At this time, the aerial shoots of the parent plant die. The same transformation occurs anytime that the parent plant or rhizome is disturbed by cultivation (Palmer & Sagar, 1963). Aerial shoots that develop in spring die in autumn or early winter (Werner & Rioux, 1977). Shoots that develop later in the season may survive the winter to a greater or lesser extent (Håkansson, 1982).

At first the rudimentary aerial shoot has only a few transitional leaves and one small shoot leaf (Palmer, 1958). The primary shoot emerges during autumn, grows slowly over-winter and by spring has 2-3 mature aerial leaves. Once the soil temperature consistently exceeds 0 °C new roots and primary aerial shoots begin to grow (Håkansson, 1982). In late March or early April active growth begins, new leaves are produced in rapid succession and the stem quickly elongates. The dormant buds at the base of each shoot grow out to form either upright tillers that resemble the aerial shoot or horizontal rhizomes. In a closed community each primary shoot typically produces three tillers and 3-4 rhizomes. In an open or disturbed community the primary shoots produce a tuft of tillers and develop abundant rhizomes. The rhizomes themselves form numerous lateral rhizomes in July. A plant may produce 150 rhizomes in the first growing season. The rhizomes generally reach lengths of 50 cm before the tips turn erect. In one growing season a rhizome may attain a length of 2 m but in a closed community maximums of 5-15 cm are more common (Palmer, 1958).

At high soil nitrogen levels tiller production increased leading to an increase in the development of secondary rhizomes (McIntyre, 1965). An increase in the nitrogen supply also reduces apical dominance in the rhizomes leading to the development of more lateral buds. The loss of apical dominance probably results from a reduction in the competition for nutrients within the rhizome. In rhizomes that were detached from the parent plant, even at high nitrogen levels, apical dominance was restored as the competition for the more limited supply of nutrients increased (McIntyre, 1969).

When a rhizome is separated from the parent plant, the axillary buds develop into aerial shoots that grow vertically upward (Palmer & Sagar, 1963). Cultivation may therefore displace the seasonal growing cycle. Renewed tillering and rhizome

production will follow soil disturbance at any time except mid-winter. The stem bases of the aerial shoots also possess a regenerative capacity and develop new plants after fragmentation (Håkansson, 1969a). Couch has a great capacity for regeneration after tillage even during the weakest stages of growth (Håkansson, 1995).

Shoots from single bud rhizome fragments begin to form new rhizomes at the 3 to 4-leaf stage. With single node fragments the greatest regenerative capacity was between November and April and the least was in June. In experiments with rhizome pieces 4 to 32 cm long planted 0-30 cm deep in soil, most shoots emerged from rhizomes in the top 7.5 cm of soil, with a peak at 2.5 cm depth. The 32 cm fragments were able to emerge from up to 30 cm deep but most emergence was from 2.5-10 cm deep (Håkansson, 1968a). It was noted that death rates for planted rhizomes increased with depth and decreased with rhizome length except on the soil surface where no rhizomes survived. The number of rhizome pieces that survived and sent out aerial shoots was much lower for 4-8 cm pieces than longer ones (Håkansson, 1968b). Weak shoots developed from short rhizome pieces, the longer the rhizome segment the stronger the shoot (Venngren, 1962).

Couch plants never develop a real innate dormancy and soil cultivation resulting in decapitation of the rhizome in any season when conditions are favourable causes immediate regrowth. The nearest bud to the apical end develops into a shoot, buds a little further from the apex produce rhizomes (McIntyre, 1970). The renewed growth follows a pattern of morphological and dry matter changes similar to that in spring. After extensive rhizome fragmentation at least one bud per fragment develops a new shoot except in winter when low temperatures retard growth. Where fragments have several buds some will remain dormant due to correlative dominance. However, it has been noted that buds are not completely inhibited for a 10-20 day period after fragmentation. Around 70-80% of buds on 7 and 15 node fragments were found to have made detectable growth in that period, only buds at the basal end of longer rhizome pieces remained dormant (Chancellor, 1968). On short fragments all the buds made significant amounts of growth until the leading bud re-imposed dominance. The longer these shoots develop before growth ceases, the more vulnerable they become to subsequent cultivations. If the lead shoot dies for any reason, the inhibited shoots recommence growth to replace it.

In undisturbed soil, where no fragmentation occurs, the majority of buds remain inactive due to apical dominance from the actively growing shoots. The parent rhizome may survive for two or more seasons depending on soil conditions and the frequency of cultivations. In well established stands where the rhizomes survive for several years the soil beneath the surface may become crowded with a mat of rhizomes of mixed ages.

Temperature and light levels can affect couch development, all buds have the potential to develop either as shoots or rhizomes and environmental conditions can influence the result. Low constant temperatures favour the growth of underground organs. Vegetative growth of couch is stimulated by exposure to low temperatures in the winter (Palmer & Sagar, 1963; McIntyre, 1967). Higher temperatures encourage top growth at the expense of rhizomes. Temperatures above 35°C depress all growth. Bud development at the base of new shoots is dependant on light intensity. At lower light levels, more buds develop into shoots and rhizome production is inhibited. In

longer photoperiods and higher light levels rhizomes are thicker and more numerous (Werner & Rioux, 1977). The strongest couch growth is achieved at low temperatures in long photoperiods. At high temperatures and short photoperiods growth is depressed. In the USA, Majek et al. (1984) rhizome tips curved upwards when grown at 32 or 10°C or given less than 10 hours light. Shading reduces plant growth, rhizome development being more affected than top growth (Håkansson, 1969b; Williams, 1970a). Rhizome growth is not affected by flower formation but growth ceases during mid-August to mid-October when the aerial shoots become senescent or growing conditions become unfavourable (Palmer & Sagar, 1963). The effect of nitrogen levels on bud development varied with the axillary position of the bud (McIntyre, 1967). At high nitrogen levels the bud in the axil of leaf one develops into tillers, at low nitrogen levels the buds form rhizomes.

Couch rhizomes exhibit the minimum regenerative capacity after deep burial in May (Håkansson, 2003). Low bud activity in spring is thought to be due to low food reserves causing low regenerative capacity (Leakey *et al.*, 1977). Rhizome buds decrease in activity from mid-April to June and then increase again from July onwards. New rhizomes develop below ground in the greatest numbers during July-August. Tillers and new rhizomes start to develop when the dry matter in the underground organs has exceeded a minimum level after the decrease due to early root and shoot development. This generally occurs when primary shoots have 3-4 visible leaves. Subsequent undisturbed growth allows a gradual dry matter increase that proceeds until autumn.

In dry soil conditions, pieces of couch rhizome have demonstrated considerable resistance to drought (Håkansson, 1970b). Couch appears able to tolerate drought because plant metabolism falls under dry conditions. In this state, the rhizomes are much less susceptible to desiccation. Plant growth is restricted, preventing the depletion of food reserves and limiting the success of control by soil tillage.

In petri-dish tests, water extracts from plant residues of common couch inhibited the germination of lettuce and radish but had less effect on clover and wheat seed (Carley & Watson, 1968). The root and hypocotyl length of seedlings of all the test species except wheat was considerably reduced..

### **Persistence and spread**

Seed can retain viability in soil for more than 5 years (Salisbury, 1961). Seed exhibited seed dormancy in excess of 3 years but seed sown in trays of soil in the field emerged mainly in the first year (Chepil, 1946). Few seedlings emerged in year 3. Seed buried in soil in subarctic conditions had <1% viability after 2.7 years (Conn & Deck, 1995).

Field margins infested with couch act as a source for repeated spread into arable fields. The rhizomes extend readily into cultivated soil. Once there, tillage fragments the rhizomes and scatters the pieces further into the field. Seed may be a more important source of new infestation than is realised and couch allowed to flower in the around the margins could set seed that would be readily dispersed within the field or beyond. However, in studies comparing weed vegetation with the weed seedbank, while common couch was well represented in the vegetation it was absent from the soil seedbank (Hill *et al.*, 1989).

Weed seed contamination of crop seed was a common source of couch infestations. In a survey of cereal seed drilled in 1970 on UK farms couch seed was found in 39% of samples from home saved seed and 5% of merchants seed samples (Tonkin & Phillipson, 1973). Sowing couch seed with the crop seed may not only contaminate clean land but may also introduce new clones to areas previously occupied by a single clone, thereby facilitating further seed production (Mackay, 1964).

In seed samples tested by the Official Seed Testing Station in 1960-61, common couch seeds were found in up to 13.8% of perennial ryegrass seed samples of UK origin and in up to 7.5% of samples of other grass seeds (Gooch, 1963). Up to 63.7% of grass seeds of Scandinavian origin were found to contain couch seed. Seed was found in 2-4% of cereal seed samples tested, an increase since 1951/52. The seed was not an important contaminant in clover, forage, root and vegetable seed samples tested at this time. In purity tests made on wheat, barley and oats between 1961 and 1968 couch seed was found around 3% of samples from 1961-67 but in 1967/8 the frequency in all the cereals had increased to over 5% (Tonkin, 1968a). In most seasons *E. repens* was the most frequent injurious weed in samples of wheat, oats and rye (Tonkin, 1968b).

At the Official Seed Testing Station for Scotland the incidence of common couch and other weed seeds in certified and pre-certified barley seed 1996/97 showed that seed of couch was present in 31.5% of pre-certified samples and 6.3% of certified samples (Don, 1997). While the incidence of most weed seeds in certified barley seed samples has decreased, there was a regular increase in couch seed from its occurrence in 0.76% of 1986/7 samples, to 3.58% in 1991/2 to 6.26% in 1996/7. A similar increase was reported in certified oat and wheat seed samples. The results are thought to be due to an increase in couch infestations following its introduction in contaminated cereal seed!

The seed retains viability after passing through horses, cows and sheep but not pigs (Mitich, 1987). Apparently viable seed has been found in samples of cow manure (Mt Pleasant & Schlather, 1994). Seed has been recovered from irrigation water (Kelley & Bruns, 1975).

### **Management**

Although vegetative spread is considered to be the main problem it is important to ensure that new infestations are not introduced as seeds in contaminated grass or cereal seed (MAFF, 1949). Once couch is established repeated ploughing, grubbing and harrowing must be practiced to reduce it (Long, 1938). The land should be ploughed shallowly and as much weed as possible collected by grubbing and harrowing when the soil is dry. The weed should be burnt and the ashes spread on the land. Isolated patches may be forked out and burnt (Weber, 2003).

Couch was controlled traditionally by cultivation, harrowing, raking and burning during fallow periods. It can be almost completely killed in one season by repeated cultivations that begin in spring (Håkansson, 1982). The optimum time for repetition of tillage is when regrowth has reached the 3-4 leaf stage (Håkansson, 2003). In a fallow period, progressively deeper spring-tine cultivations aim to bring rhizomes to the soil surface to be desiccated. Actively growing rhizomes are readily killed by

desiccation when exposed to dry air for a few days at moderate temperatures (Low & Buchholtz, 1952). However, if covered even with a shallow layer of dry soil the rhizomes may survive. The best time to work the land is when the soil falls readily from the rhizomes. Rolling greatly assists the harrows in shaking of the soil (MAFF, 1949). Repeated cultivations are not good for a poorly structured soil but a full fallow should not be needed on light land.

In Norway, ridge fallowing was regarded as the most effective system of fallowing (Bylterud, 1965). After ploughing and harrowing the soil is laid up in large ridges 75 cm apart. When the couch grass shoots are 5 cm long the ridges are split with a plough. In this way some rhizomes are dry out on the surface others are cut up and buried. The splitting is repeated 5-6 times at intervals of 10-20 days. Unfortunately ridge-fallowing is best performed with a one share broad plough. Some ploughs with multiple shares may not invert the soil fully leaving strips of couch grass visible between slices. Autumn fallowing has been used in Denmark when there is low precipitation and the cultivations after cereal harvest are used to bring couch rhizomes to the surface for drying out. However, if conditions are too dry couch growth ceases and soil tillage has no effect on the dormant rhizomes.

A bastard or half fallow can precede fodder or vegetable crops in spring or ploughing can be delayed following forage crop or early cereal harvest (MAFF, 1974). Vetches or a mixture of oats and vetches may be sown in autumn (or oats and peas in spring) for making into hay or silage. As soon as this crop is removed the land is ploughed and fallowed until autumn (MAFF, 1949). A short rotation including extra root or hoed crops is of value in combating couch. The use of a smother crop such as Lucerne or clover has sometimes proved effective (Salisbury, 1961).

In cropping systems without fallow periods, apart from repeated inter-row cultivation in row crops, the main period for couch control is after harvest. In cereals it is critical that rhizome fragmentation takes place as soon after harvest as possible. A tractor mounted L-blade rotavator working to a depth of 15-cm is needed to cut the rhizome into short lengths (Fail, 1956). The first cultivation should cut rhizomes into 2.5-15 cm lengths many of which will perish or partially die back. Survivors will develop a new root and shoot at one node; a further rotavation 2-3 weeks later will kill many of these. Rotavation needs to be repeated when survivors have developed shoots 5-10 cm long (2-leaf stage). Allowing regrowth to remain beyond 15 cm tall (3-4 leaf stage) before reburial will replenish the food reserves and make control less effective. The number of cultivations needed to eradicate the weed varies between 2 on light friable soil to 6 on heavy clay.

In barley stubble, a single rotary cultivation in late-August-early-September reduced spring shoot emergence by 80% (Cussans & Wilson, 1970). A second cultivation, 3 weeks later when regrowth had 1-2 leaves, reduced spring emergence by 90%. In addition to the rotary cultivations, the land was ploughed, cultivated and drilled with spring barley. In Canada, repeated tillage from the beginning of August has given excellent couch control (Werner & Rioux, 1977). Rotary cultivations after cutting hay in July/August gave better control than disking and ploughing (Lowe & Buchholtz, 1952). In New Zealand, undersowing cereals with clover had no apparent effect on couch shoots. A summer fallow during which the soil was rotary hoed three

times eliminated couch while a single rotary hoeing followed by a green feed crop did not (Popay & Stiefel, 1994).

Proctor (1960) found that the level of control of rhizomatous grass weeds with a rotary cultivator was limited by the machinery used. With a 'Howard Rotavator' towed by an underpowered tractor PTO speed was inadequate at a reasonable penetration depth. Even on a light silty soil the final depth was 4 inches while rhizomes had been ploughed down to 11 inches. A 'Selectatilt Rotovator' with a wider range of motor speeds and powered by a more powerful tractor gave deeper penetration although dry soil conditions made this difficult to achieve. Control was reasonable but more rhizomes were brought to the surface by deep ploughing to break up any soil pan that the rotovations may have produced

Ploughing to 30 cm will bury foliage and rhizomes under 15-20 cm of soil (MAFF, 1974). The aim of deep burial is to cause activated buds to perish without establishing aerial shoots or to exhaust the rhizomes food reserves as it regrows to the soil surface. Vengris (1962) recommends cutting rhizomes into short lengths by cultivation, allowing shoots to grow to 2-3 inches then ploughing under to at least 6 inches. Repeated rhizome fragmentation without deep burial leads to an increase in the number of aerial shoots rather than greater rhizome production (Håkansson, 1968b). The minimum capacity for recovery from burial was generally when rhizome pieces had aerial shoots 12-15 cm long with 3-4 leaves and with new rhizomes and tillers about to develop (Håkansson, 1967; 2003). It was noted that couch infestations declined over a 3-year period in a field cropped with spring barley when a change of plough increased the depth of burial of the rhizomes (Scragg, 1981).

Cutting the aerial shoots from regenerating rhizome pieces at weekly intervals inhibited further rhizome production and may kill plants eventually but less frequent cutting was not successful. Cutting at soil level was more effective than at 2 cm above the soil surface. The time of year has not been shown to be of importance in measures to deplete food reserves.

Competition from the crop can enhance the control of couch weakened by burial or fragmentation but, in general, smother crops alone have less effect on couch growth than cultivations (Lowe & Buchholtz, 1952). Seedlings of couch were much more susceptible to competition from wheat than plants derived from single node rhizome pieces. The faster emergence and initial growth of the wheat seedlings reduced biomass of even the rhizome derived plants by 77% (Williams, 1973b). When the couch and wheat seedlings were grown alone, the later growth of the weed was much faster than that of the cereal mainly due to a greater leaf area (Williams, 1970b). In some grass fields uniformly infested with couch, there was a gradual decline in the occurrence of couch from three years after establishment until recording stopped in year ten. It has been said that if land is laid down to grass, couch will be eradicated in 2-3 years (Morse & Palmer, 1925). Competition suppressed the growth of *E. repens* in headlands sown with grass or wildflower/grass mixes in comparison with unsown headlands (West et al., 1997). The ingress of the weed from the field margins was reduced but not prevented.

Couch was not controlled by flame weeding and regenerated rapidly after treatment (Ivens, 1966; Bertram, 1997).

Couch will not persist under a system of close grazing. If a suitable mixture of grasses and white clover is sown and efficiently managed for a few years the weed will be gradually suppressed (MAFF, 1949). Pigs in a moveable pen will root out and consume the rhizomes (Mitich, 1987). The rhizomes are also said to be relished by horses and cattle (Morse & Palmer, 1925).

Like many weeds, common couch often occurs in patches that may require different treatment from the rest of a field. Techniques have been developed for mapping the spatial distribution of couch to facilitate patch spraying of the weed with herbicide (Rew *et al.*, 1996). It may be possible to use similar techniques to monitor weed spread and for treating weed patches using non-chemical methods. Mathematical models for the calculation of the rates of change in the size of weed infestations may be used to simulate weed management scenarios for common couch (Mortimer & Putwain, 1981).

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