

Weed Management in Grain Legumes: Peas, Beans and Lupins

SUMMARY

This Technical note describes options for weed management in grain legumes, including weed management by husbandry, rotational and reactive physical methods for organic farming, as well as with herbicides.

- **Grain legumes, particularly peas and lupins, do not offer strong competition to weeds.**
- **On most sites, weed control is essential to reduce yield loss and harvest difficulties, and to reduce grain contamination with unwanted seeds and other plant material.**
- **Good weed management should be maintained throughout the rotation. Weed control can be undertaken before sowing the crop and within the crop by physical or chemical methods.**

The Crops

Peas: These may be grown for animal feed (combining and forage peas) and for human consumption as vining peas, dried processing peas and mange-tout or whole-pod peas. Some pea varieties can be sown in the autumn, but this is rarely done and not covered here.

Compared with many other arable crops, peas are not strongly competitive with weeds. The average yield loss due to weeds in PGRO trials over 5 years was 15% , with a range of 8-24% (The Agronomist, 1/2000 Issue). The competitiveness of peas varies between varieties, as shown in Table 1, with leafless and semi-leafless varieties generally considered more susceptible.

Some weeds can also affect the crop by causing lodging, such as *cleavers* and *black-bindweed*. The pea grain can be contaminated by plant material at harvest, which is a serious problem in crops destined for human consumption. In particular, the seed and fruit of some weeds are difficult to clean out from peas and some, such as *volunteer*

potato 'apples' and *nightshades'* fruit, can also be toxic to humans and animals. Harvesting operations can also be affected by the presence of stemmy weeds, such as *fat-hen* and *charlock*, and entangling weeds such as *knot-grass*.

Field and Broad Beans: Most Scottish field bean crops are grown for combining dried for animal feed and for export for human consumption in the Middle East. Broad beans for human consumption, mostly as frozen fresh beans, are also produced. Crops may be autumn or spring sown, with the spring sown varieties being by far the most common.

Beans are much more competitive than peas because of their rapid spring growth and height. They generally grow away from weeds; however, some tall and climbing weeds can provide harvesting and grain contamination problems. However, the lateness of harvest usually means that weeds have shed their seed beforehand.

Lupins: These crops are grown for combining dry for animal feed in most situations. There are spring and winter varieties, with spring sown

varieties dominating. They are poorly competitive with weeds, which can readily outgrow the lupins early in spring. If early weed control is successful, then once the full crop canopy develops, it can suppress further weed germination. However, the crop is in the ground for a long time and there can be several flushes of weeds in a wet season.

Preventative Weed Management

Preventative weed management approaches the targeting of weeds throughout the rotation and attempts to maintain weed seed bank populations at a level where direct control actions within the crop have a greater chance of success. This is critical in organic crop production, but is also of importance in conventional systems where herbicide choice is becoming increasingly limited.

Management throughout the rotation: The importance of weed management throughout the rotation is often under-estimated, Grass breaks of 2-3 years are very useful in suppressing the seed banks of many annual weeds. The growing of highly competitive crops in other parts of the rotation also help, as does maintaining high levels of weed control within those other crops. This is particularly important where perennial weeds, and weeds with long-lived seed banks, are a problem. Weeds that are a particular problem in grain legumes, such as those that may cause harvesting or grain contamination problems, should be targeted in rotational management strategies.

Stale and false seedbeds: These techniques involve preparing a rough seedbed several weeks before sowing the crop to stimulate a flush of weeds, so reducing the seed bank available to affect the crop. The small weeds can then be killed before the crop is sown.

In autumn sown crops there is good opportunity to use this technique and such a delay in sowing also means that the crop is more likely to miss the main flush of autumn weeds. In particular this reduces the chances of severe grass weed problems. This technique, however, is of no value if field beans are ploughed-in rather than direct drilled.

In spring sown crops, the technique improves management of early emerging weeds such as *meadow-grass*, *charlock*, *hemp-nettle*, *knot-grass* and *chickweed*, but later emerging weeds, such as *fat-hen* and *redshank*, may be less well managed.

Sowing rates and patterns: Crops grown at higher seed rates tend to compete more effectively with weeds. This must be balanced with optimum seed rates for matching economic yield benefits. Grevsen (2000; vide Davies & Welsh, 2003) in Denmark found that increasing seed rate of peas from 90 to 150 seeds m⁻² reduced dry weight of weed plants by 40%.

There is some evidence that broadcast sowing of crops rather than growing in rows adds to the ability of the crop to compete with weeds. However, this reduces the ability of the grower to control weeds in the crop in no-herbicide systems as inter-row hoeing is not possible.

Physical weed control in the crop

Pre-emergence of the crop: Prior to emergence of the crop, small weeds can be removed in the seedbed with flame-weeders or infra-red burners. This may be a risky practice in shallow broadcast pea crops. It is also possible to use very shallow harrowing if the seed or crop plumule (seed shoot) is still well below the soil surface. This is most likely to be possible in deeper sown bean crops.

Post-emergence of the crop: Physical or mechanical methods of weed control within emerged grain legume crops can be broadly split into two methods: selective (i.e. inter-row weeders) or non-selective (i.e. spring-tine or harrowing weeders).

- *Spring-tine weeders*, such as by Harrowcomb or Einbock, are the most widely used form of mechanical weed control. They can be used in row or broadcast crops, although the latter are less tolerant and must be well established if shallow sown.

These rely on the many tines to create a tilth to bury weeds, or ripping them out of the ground, resulting in desiccation. The best control is obtained with slightly moist (not wet) soil conditions followed by at least 24 hours of drying weather. Larger diameter tines increase the intensity of treatment, as does increasing the forward angle of the tines. The smaller the weeds, the better the effect. Once weeds are established, particularly if they have a tap root, control can be poor. Grass weeds are less well controlled than broad-leaved weeds.

Early weed control in the emerged crop can be very successful in the spring, although the crop is also vulnerable to soil coverage at this time. However, grain legumes can recover well from this, and early foliar damage. Crop selectivity reduces as the crop develops, so early treatments are preferred.

It is probably inadvisable to use spring-tine weeders in the autumn as the crop may not be able to recover well from damage at that time of the year. Soil disturbance at this time is also liable to increase nitrogen losses from the soil.

- *Inter-row hoeing* is much more effective in controlling larger annual and perennial weeds than spring-tine weeding. If perennial weeds, such as thistles and docks, are a problem, then this approach is recommended. Such hoeing can be carried out by a range of equipment, from standard A-blades to various rolling cultivators, such as brush-weeders. Increasing the A-blade angle from the horizontal increases the intensity of weeding. The angle of rotary cultivators can be adjusted to do the same. However, this can also increase the risk of disturbance of the crop.

Inter-row hoeing requires that the crop rows are about 200mm apart for weeding with blades; possibly less for some rotary cultivators. However, this row width is unlikely to be economically feasible for pea crops, although it has been used successfully in beans and lupins.

Use of herbicides in the crop

The selection of herbicides will depend on the crop type, its potential use, the variety, crop growth stage and condition of the foliage, soil type and condition and weeds expected or present. The herbicides available for these crops are listed in Table 3, with more details on use in Table 2.

Table 4 lists the efficacy of the herbicides on major broad-leaved weeds and annual meadow-grass, whilst Table 5 lists efficacy of graminicides on grass weeds. The use of each herbicide is described in more detail in the box below. It should be noted that trifluralin-based treatments are included in Table 2, but omitted from Tables 4 and 5 as they will not be available for purchase after 30 March 2008 or use after 20 March 2009. The weed tables also do not list total herbicides used pre-sowing or emergence or as a weed and crop pre-harvest desiccant, although they are included in Table 2.

Pre-sowing and pre-emergence contact treatments

Where weeds emerge before the crop is sown, or well before it is ready to emerge, treatments based on glyphosate, paraquat+/-diquat and glufosinate-ammonium can be used. This is not crop dependant, but is not recommended on shallow broadcast crops unless well covered with soil. Use of paraquat is not approved as from 11 July 2008. A diquat only product is available for this timing.

Potential use for the crop

Where the crop is destined for human consumption, check Table 2 and the herbicide product label as to whether the treatment is suitable. Check also whether your customer considers the treatment is suitable. In many cases the customer or their agent have a prescribed choice as to which herbicides can be used in crops. This is generally not a problem in crops destined for animal consumption.

Crop variety

Some herbicides have restrictions as to which varieties may be treated. You should check the product label for such restrictions, and if your product is not listed, contact your chemical supplier for information.

Crop growth stage

Note carefully the recommendations on product labels for treatment timings. Application outwith such timings may damage the crop or break harvest interval requirements, which can result in unacceptable residue levels in crops.

Table 1: The impact of varietal competitiveness on weed growth in peas (from Grevsen, 2000; vide Davies & Welsh 2003)

Variety	Dry Weight of Weeds g/ m ²	Weed Numbers no/m ²
Dinos	160 ^a	348 ^a
Argona	154 ^a	274 ^{ab}
Kermit ¹	140 ^a	228 ^{ab}
Bella ¹	136 ^a	261 ^{ab}
Rani	117 ^{ab}	273 ^{ab}
Ambassador	88 ^b	180 ^b
Greenshaft	80 ^b	237 ^{ab}
Jaguar	80 ^b	186 ^b

Means with a different letter are significantly different (P <0.05)

¹ Semi-leafless pea variety

Crop foliage condition

The crop foliage should be well-waxed and not damaged by wind-abrasion, frost, pests, diseases or nutrient deficiency before using post-emergence treatments. Foliage wax levels can be tested by dipping foliage in crystal violet solution. The solution runs off the foliage if it has sufficient wax and stains otherwise. The test kit is available from pesticide suppliers.

Soil type and condition

Take care when using soil-acting herbicides that the correct rate is being applied for the soil type (see the box below). Dry soil conditions, cloddy soils, trash or straw cover and burnt straw residues can reduce the effectiveness of residual herbicides. If in doubt about soil type or conditions, consider using a post-emergence herbicide, but check that a product is available for your weed control targets. For beans there are few post-emergence options, and no broad-spectrum options for lupin crops.

References

The Agronomist, 2000, 1.

Davies & Welsh, 2003 in 'Organic Cereals and Pulses' eds: D Younie, B R Taylor, J P Welch, J M Wilkinson; Chalcombe Publications.

www.government.pesticides.gov.uk

Before using any pesticide product it is essential that the user reads the product label carefully and comply with the label instructions. The information provided in this Technical Note is not a substitute for the product label. Full information on the safe use of pesticides for the user and environment is available from the Pesticides Safety Directorate at www.government.pesticides.gov.uk

Table 2: Herbicide products Spring 2008

Residual only herbicides

<i>Chlorthal-dimethyl (Dacthal W75)</i>	Use up to 9kg/ha product before crop and weed emergence. Do not use on sandy or gravelly soils. SOLA 2006/1549 for edible podded peas.
<i>Clomazone (eg Centium 360CS, Cirrus CS)</i>	Use up to 250mls/ha before crop and weed emergence. Crop seed must be covered by min. 20mm soil. Do not use on broadcast crops. Do not use on Sands or very light soils or soils with >10% organic matter. Activity reduced on dry or cloddy soils, Some temporary foliar 'whitening' has been seen from which the crop normally recovers fully.
<i>Linuron + trifluralin (Blois)</i>	Use up to 3.75l/ha before crop and weed emergence on light/medium soils within 3 days of sowing. Crop seed must be covered by min. 30mm soil. Do not use on Sands or soils with >10% organic matter. Effectiveness reduced on dry or waterlogged soils. Approval for use ends on 20 March 2009.
<i>Trifluralin (various products)</i>	Use 2-3l/ha before crop and weed emergence, pre-sowing incorporated. Broad beans should be drilled below the incorporated depth. Do not use on Sands, fen soils or with >10% organic matter. Approval for use end 20 March 2009.
<i>Pendimethalin (various products)</i>	Dose varies with product. Use before crop and weed emergence as soon as possible after sowing. Do not apply if seedling plumule is less than 13mm from soil surface. A min. 25mm of settled soil above crop seed. Efficacy reduced on dry or cloddy soils or where >6% organic matter.
<i>Pendimethalin + imazamox (Nirvana)</i>	Use up to 4.5/ha before crop and weed emergence. Do not apply if seedling plumule is less than 13mm from soil surface. A min. 25mm of settled soil above crop seed. Efficacy reduced on dry or cloddy soils or where >10% organic matter. Do not use on soils prone to waterlogging.
<i>Propyzamide (various products)</i>	Dose depends on formulation. Use within 7 days after drilling, before crop emergence in winter beans, from 1 October-31 December. Use only on medium to heavy loams with <10% organic matter.

Residual + foliar acting

<i>Bentazone+ PDM (Impuls)</i>	Twin-pack: 1.5l A + 2l B/ha, used before third node stage of combine peas. NB Varietal limitations. Seed should be covered with 25mm settled soil. Do not use on soils prone to waterlogging, stony/gravelly soils. Efficacy reduced in soils >6% organic matter and dry, cloddy soils. Do not use in sunny conditions where >21oC; delay until cool of evening. Test crop foliage wax with crystal violet test before use.
<i>Carbetamide (Carbetamex, Crawler)</i>	Use 3kg/ha from November- end February pre- or post-crop emergence. Do not apply when weeds are fully dormant. Do not apply to waterlogged soils or stressed crops. Efficacy affected where >10% organic matter, or dry or cloddy soils.
<i>Isoxaben+ PDM (Skirmish)</i>	Use 1l/ha pre- or post-emergence (before second node/ seedling weeds) in peas, pre-emergence in beans. Do not use on soils lighter than CSL, where >10% organic matter or stony or cloddy soils. Seed should be covered with at least 25mm soil.

Contact/ foliar activity only

<i>Bentazone (Basagran 5G)</i>	Single application of 1.65l/ha in peas, single or split-dose in beans to take successive flushes of weeds. From 3 nodes > flowerbud in peas; 2>6 leaf pairs in spring beans, to 15cm height. 2-7 leaf pairs in winter beans. NB Varietal limitations. Weeds controlled at cotyledons > young plant stages. Do not use in sunny conditions where >21oC; delay until cool of evening. Test crop foliage wax with crystal violet test before use.
<i>Bentazone+ MCPB (Pulsar)</i>	Use 2-4l/ha from when crop has 3 leaves to before flowerbud in peas. NB Varietal limitations. Weeds controlled at cotyledons > young plant stages. Do not use in sunny conditions where >21oC; delay until cool of evening. Test crop foliage wax with crystal violet test before use.
<i>Diquat (Mission, Retro)</i>	Use before sowing or pre-emergence up to 2l/ha. On sandy or peaty soils allow 3 days before sowing of crop emergence. Further products to be expected in 2008.
<i>MCPA+ MCPB (Impetus, Triflex-Tra)</i>	Use 2l/ha from 4 nodes to before flowerbuds in peas. NB Varietal limitations. Do not apply if >21oC.
<i>MCPB (various products)</i>	Dose varies with product from 3 nodes to before flowerbuds on peas. NB Varietal limitations.

Table 2: (continued) Herbicide products Spring 2008

<i>Cycloxydim (various products, eg Laser)*</i>	Use up to 2.25l/ha from 3 nodes in peas and 2 leaf pairs in beans, to full canopy cover. Test crop foliage wax with crystal violet test before use. Harvest interval 5 week peas, 8 week beans.
<i>Fluazifop-P-butyl (Fusilade Max)*</i>	Use up to 1.5l/ha from 4 nodes in peas and 2 nodes in beans, to before flowerbuds. Test crop foliage wax with crystal violet test before use.
<i>Propaquizafop (various products, eg Falcon)*</i>	Use up to 1.5l/ha from 3 nodes in peas and 2 leaf pairs in spring beans, 4 leaf pairs in winter beans, to full canopy cover. Test crop foliage wax with crystal violet test before use. Harvest interval 7 week peas, 14 week beans.
<i>Quizalofop-p-ethyl (Co-Pilot, Sniper 100)*</i>	Use up to ----- from 3 nodes in peas and 4 leaf pairs in beans, to full canopy cover. Test crop foliage wax with crystal violet test before use. Harvest interval 5 week peas, 8 week beans.
<i>Quizalofop-p-tefuryl (Panarex)*</i>	Use up to ----- from 3 nodes in peas and beans, to full canopy cover. Test crop foliage wax with crystal violet test before use. Harvest interval 60 days.
<i>Tepraloxymid (various products, eg Aramo)*</i>	Use up to 1l/ha from 2 nodes in peas to full canopy cover ; 3 leaf pairs in winter beans, to 6 extending internodes stage; 2 leaf pairs in spring beans to first shoot detectable. Test crop foliage wax with crystal violet test before use. Harvest interval 5 week peas, 8 week beans.

* There may be resistance in some grass weeds (notably black-grass, rye-grass and wild –oats) to –fop and –dim (ALS inhibitors) herbicides. For further information on resistance development read the guidelines produced by the Weed Research Action Group, published and available from HGCA, (publications@hgca.com).

Read the product label or contact your distributor before mixing any of the herbicides listed above.

Table 3: Approvals for herbicides in pulse/legume crops, 2008

Herbicide	Combine peas	Vining peas	Forage peas	Edible podded peas/ mange tout	Winter field beans	Spring field beans	Broad beans	Lupins	Products
Residual									
Chlorthal-dimethyl	-	-	-	SOLA	-	-	-	-	Dacthal W75
Clomazone	A	A	-	-	A	A	-	SOLA	eg Centium 360CS, Cirrus CS
Linuron+ trifluralin*	A	A	-	-	A	A	A	SOLA	Blois
Pendimethalin (PDM)	-	SOLA	-	SOLA	SOLA	SOLA	-	SOLA	Various+
PDM+ imazamox	A	A	-	-	A	A	-	-	Nirvana
Propyzamide	-	-	-	-	A	-	-	SOLA	Various+
Trifluralin*	-	SOLA	-	-	A	A	A	-	Various+
Residual+some foliar activity									
Bentazone+ PDM	A	-	-	-	-	-	-	-	Impuls
Carbetamide	-	-	-	-	A	-	-	SOLA ¹	Carbetamex/ Crawler ¹
Isoxaben+ terbuthylazine	A	A	-	-	-	A	-	-	Skirmish
Contact/ foliar activity only									
Bentazone	A**	A**	-	-	A**	A**	A**	-	Basagran/ Pulse
Bentazone+ MCPB	A**	A**	-	-	-	-	-	-	Pulsar
MCPA+ MCPB	A ¹²	A ¹²	A ¹	A ¹	-	-	-	-	Triflex-Tra ¹ / Impetus ²
MCPB	A ¹²	A ¹²	A ²	A ²	-	-	-	-	Bellmac Straight ¹ / Tropotox ²
Cycloxydim	A	A	-	SOLA	A	A	SOLA	SOLA	Various+; eg Laser
Fluazifop-p-butyl	A ¹²	A ¹²	-	-	A ¹²	A ¹²	SOLA ¹	-	Fusilade Max ¹ / Bantry ²
Propaquizafop	A	-	-	-	A	A	-	SOLA	Various+, eg Falcon
Quizalofop-p-ethyl	A	A	-	-	A	A	-	-	Co-Pilot/ Sniper 100
Quizalofop-p-tefuryl	A	-	-	-	A	A	-	-	Panarex
Tepraloxymid	A	A	-	-	A	A	-	SOLA	Various+, eg Aramo

*Trifluralin product approvals for use will end by 30 March 2009; ** Varietal limitations- read the label.+ Various products. Check the label for approved uses and with the Pesticide Safety Directorate through www.pesticides.gov.uk for details of off-label approvals (SOLA)

Table 4. Susceptibility of common annual broad-leaved weeds and annual meadow-grass to herbicides for grain legumes

	Annual meadowgrass	Black bind-weed	Black nightshade	Charlock	Cleavers	Common chickweed	Common fumitory	Corn marigold	Corn spurrey	Crane's-bills	Creeping thistle	Fat-hen	Field pansy	Field poppy	Field speedwell	Foot's parsley	Groundsel	Hemp- (day-) nettle	Ivy-leaved speedwell	Knot-grass	Mayweeds	Oilseed rape	Orache	Pale persicaria	Red dead-nettle	Redshank	Shepherd's purse	Sow-thistles	Wild radish/ Runch	
Pre-emergent residuals																														
Chlorothal-dimethyl	M	M	M	m	-	S	R	R	-	-	-	S	S	-	S	-	R	-	R	S	R	-	-	M	m	R	-	-	-	
Clomazone	m	m	m	-	S	S	-	-	-	-	-	m	-	-	m	S	m	-	m	m	-	-	m	m	S	S	m	-	-	
Pendimethalin ¹	S	S	S	-	M	S	M	S	-	-	-	S	S	S	S	-	-	S	S	S	M	M	S	S	M	M	S	-	-	
Pendimethalin+ imazamox	-	S	-	S	-	S	S	-	-	-	-	S	m	S	S	m	-	-	S	S	M	M	S	S	S	m	-	M	-	
Propyzamide	S	M	M	-	m	S	-	-	-	-	-	M	-	-	M	-	-	-	M	M	-	-	-	-	M	-	-	-	-	
Residual + some foliar activity																														
Bentazone+ Pendimethalin ³⁵	-	M	S	S	S	S	S	-	-	-	-	S	S	S	S	M	-	-	M	S	S	S	S	M	S	S	-	S	-	
Carbetamide	S	-	-	-	S ¹	S	S ¹	-	-	-	-	S ¹	-	-	S	-	-	-	S	S ¹	-	-	-	-	-	-	-	-	-	
Isoxaben+ Terbutylazine ⁵	S	M	-	S	-	M	S ⁴	-	-	-	S ¹	S ¹	S	S	S	S ¹	-	S	S	m	S ⁴	M	-	S ²	S ¹	S ¹	S ¹	-	-	
Contact/ foliar only																														
Bentazone ²³⁴	R	M	S	S	S	S	M	S	S	S	M	M	R	M	M	S	M	m	m	m	S	S	-	S	S	S	M	S	-	
Bentazone+ MCPB ²³⁴	R	S	M	S	M	S	S	-	-	S	-	S	M	-	S	M	S	M	S	m	S	S	-	S	S	S	M	M	-	
MCPA+ MCPB	R	-	-	S	R	R	m	R	-	-	M	S	R	m	R	-	R	m	R	R	R	-	m	-	R	-	m	m	m	
MCPB	R	M	-	S	R	-	M	R	-	-	M	S	-	S	-	S	R	M	-	S	R	S	m	-	S	S	m	R	R	

¹Pre-emergence activity indicated; ² weed cotyledons only; ³ up to 2 leaves weeds; ⁴ up to 4 leaves weeds; ⁵ variation in pre-and post-emergence between weed species; ²³⁴ variation in post-emergence activity. S: Susceptible; M: Moderately Susceptible; m: Some Activity (Moderately Resistant); R: Resistant
 NB: This is a general guide; see the product label for full details.

Table 5. Susceptibility of grass weeds to graminicides for grain legumes

	Annual meadow-grass*	Rough meadow-grass	Volunteer barley	Volunteer oats	Volunteer wheat	Barren brome	Soft brome	Wild-oats	Italian tyre-grass	Perennial rye-grass	Black-grass	Loose silky-bent	Common couch-grass
Residual activity													
<i>Pendimethalin</i>	S	S	-	-	-	-	-	-	-	-	M	-	-
Residual + somefoliar activity													
<i>Carbetamide</i>	S	S	S	S	S	-	-	S	S ¹	S ¹	S	-	m
<i>Propyzamide</i>	S	-	S	S	S	S	-	-	-	-	S	-	-
Foliar activity only													
<i>Cycloxydim</i>	-	-	S	S	S	S	S	S ²	S ¹²	S ¹²	S ²	S	M
<i>Fluazifop-P-butyl</i>	-	-	S	S	S	S	-	S ²	S ¹²	S ¹²	S ²	-	M
<i>Propaquizafop</i>	-	-	S	-	S	-	-	S ²	S ¹²	S ¹²	S ²	-	M
<i>Quizalofop-p-ethyl</i>	-	-	S	S	S	-	-	S ²	S ¹²	S ¹²	S ²	-	M
<i>Quizalofop-p-tefuryl</i>	-	-	S	S	S	-	-	S ²	S ¹²	S ¹²	S ²	-	M
<i>Tepaloxymid</i>	S ¹	-	S	-	S	S	-	S ²	-	-	S ²	-	M

¹ seedlings; ² note label regarding the potential for development of resistance.

S: Susceptible; M: Moderately Susceptible; m: some activity (Moderately Resistant)

* Annual meadow-grass susceptibility to general herbicides listed in Table 4.

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