

Weed control in the Potato Crop

SUMMARY

This technical note describes the options for weed control in potatoes. A constantly changing legislative environment has resulted in fewer herbicide options since the last technical note on this subject. This technical note covers conventional herbicide options in the potato crop but has potential interest to organic systems.

- **Potatoes are not competitive to weed growth up to canopy closure.**
- **Main Crop varieties are more competitive than second earlies, seed crops and salads.**
- **Climbing weeds such as cleavers and black-bindweed can be difficult to control. Other weeds such as fat-hen, knot-grass volunteer rape and annual meadow grass can cause harvest problems.**
- **Impacts of EU legislation on herbicide availability are mentioned. This may require an update to this note as products are lost. There are few new herbicide active ingredients in the development pipeline. Current herbicide options are described in the note.**
- **Weed spectra of various herbicide programmes are included. Note this list is not exhaustive.**
- **Organic/physical weed control options are covered in the note.**

1. Introduction - The problem

The potato crop is particularly vulnerable to competitive weeds during the period from emergence to canopy closure. Some varieties and crop types such as salads may only be in the ground for 100 days and are not as competitive as more vigorously growing varieties. Second early varieties such as Estima and Saxon produce a less competitive canopy than main crop varieties such as Maris Piper and are less competitive to weeds especially tall weeds such as fat-hen and volunteer rape. The potential vigour of weed growth is increased when crops grown under cover and not all residual herbicides are recommended for application to covered crops. Some weeds such as grasses, fat-hen and volunteer rape compete for costly nutrients and water leading to reduction in yield and marketable tuber size, others as such as knotgrass, cleavers and bindweed grow through the crop and can be a nuisance at harvest, blocking webs and rollers.

Three pieces of EU legislation, EU91/414, the Water Framework Directive, (WFD) and the Drinking Water Directive, (DWD), will have a direct effect on currently available herbicides approved for use in the potato crop. There will also be impacts in the medium term on weed populations due to herbicide losses elsewhere in the rotation.

Loss of certain herbicides in potatoes has already had an impact with the withdrawal of paraquat and reduction in dose rates for linuron, down to a maximum of 600gm active ingredient per ha, (ai/ha). Linuron, a key residual herbicide is presently used on 66% of the potato crop, (Defra National Statistics 2006). Other residuals under threat from EU91/414 are pendimethalin and metribuzin, although like linuron the result may be limited to a reduction in total dose per crop. Pendimethalin is used on only 5.95% of the national crop where as metribuzin is used on 26%, (Defra National Statistics 2006). Substituting metribuzin for a lower dose of linuron will be limited by varietal tolerances to metribuzin. The

contact herbicide, glufosinate ammonium, (Basta) is almost certainly to be withdrawn under EU91/414. The situation is further compounded by few new residual/contact herbicides in the development pipeline for the potato crop.

In a report conducted by ADAS for the British Potato Council in May 2009 a yield loss of 10 % resulting from poorer weed control, resulting from the impact of EU 91/414 and WFD on herbicides, would cost the industry £100m.

The use of pre-emergence residuals can, to some extent be substituted by post emergence herbicides such as bentazone, (Basagran) and rimsulfuron, (Titus/Tarrot). However bentazone is being found in water and at risk from the Water Frame Work Directive. If bentazone were lost, the only post emergence product would be rimsulfuron and it may not be applied to seed crops and has a limited weed spectrum. Cultural and physical methods of weed control, such as inter-row weeding may become more widely acceptable for post emergence weed control and are widely used in organic crops, see later section.

The herbicide used in potatoes needs to give 6-8 weeks control, generally up to the point when the canopy closes across the row and the crop is at its most competitive. To optimise weed control it is best to wait until there is a flush of weeds and apply a mix of contact and residual herbicide before crop emergence. Some residuals have foliar as well root uptake but generally a mix is used.

Classification of herbicide groups used on Potatoes

A. Contact herbicides

The contact herbicides as a group are rarely used on their own, but mixed with a residual herbicide. The potato crop is not tolerant to any of the contact herbicides so the aim is to apply them before crop emergence. However adverse weather or competing pressures such as planting can so often delay application. There is often a fine line between waiting until there is a flush of weeds, emergence of the potato crop and application of the herbicide. Waiting too long and the grower risks damaging the newly emerging foliage thus setting the crop back.

- Diquat, marketed by Syngenta as Retro with other generic formulations also available. It currently has a label rate for 2.0lt/ha but Syngenta are actively seeking approval for a maximum dose of 4.0lt/ha which may be available for spring 2010. Experience has shown that that the 2.0lt rate can give poor control of grass weeds and large polygonums such as knotgrass and black bindweed. Diquat is approved for ware potatoes up to 40% emergence and on seed crops up to 10% emergence. Diquat is usually mixed with a residual herbicide such as linuron or metribuzin or a combination of both. It is recommended that an adjuvant such as Activator 90 is used except in a tank-mix with prosulfocarb, (Defy).
- Carfentrazone ethyl, marketed by Belchim Crop Protection as Shark for weed control in potatoes and also as Spotlight Plus as a haulm desiccant. The label rate is 0.33lt/ha for ware and seed crops up to first plants breaking the surface or cracking on the surface of the ridge. Carfentrazone is a "burner" product but has no activity on grass weeds. Like diquat it is usually mixed with a residual such as Linuron or Metribuzin. It can also be mixed with diquat to broaden the activity on polygonum weeds.

- Glufosinate ammonium is marketed by Bayer Crop Science as Basta. Glufosinate uniquely controls the full spectrum of annual grass and broadleaved weeds in potatoes and is approved across all potato crops pre-crop emergence and before ridge cracking. It does, however require 6 hours free of rain after application and works best in bright sun light. These requirements have limited it's market penetration in recent years. As with other contact herbicides it is usually used in tank-mix with a residual herbicide.
- Glyphosate marketed by Monsanto. For 2009 Monsanto gained approval for Roundup Ace, Roundup Energy and Roundup Klik for pre-emergence application at rates of 1.2lt/ha. At this rate it will control newly germinated annual and perennial grasses prior to crop emergence. Monsanto suggest mixing with a residual such as linuron, metribuzin or pendimethalin or the contact carfentrazone. The latter will increase the speed of action.

B. Warnings

- The potato crop is particularly sensitive to herbicides used on other crops such as cereals oilseed rape, grass and fallow/setaside. After spraying cereal crops for broad leaved weed control with sulfonyl-ureas such as Harmony M SX the sprayer should be cleaned with a recommended tank cleaner such as All Clear Extra. If renting ground check the history of the field and if any FYM has been applied check the history and source. Ask if has been derived from stock fed on grass treated with a herbicide containing aminopyralid or clopyralid.
- Glyphosate damage is usually as a result of spray drift although crop damage has been known to occur from simply choosing the wrong product from the store. Glyphosate damage is particularly insidious on seed crops, as a contamination it can affect the performance of the succeeding crop. If the contamination is not detected the potential damage in subsequent crops can be huge with serious economic consequences for the grower.

C. Residual Herbicides

Residual herbicides require moist soil and clod free drills to work. If the ridge is dry after planting it may best practice to delay application of the residual as late as possible before crop emergence or split the contact from the residual component.

Excessive rain after application of residual herbicides, especially on sandy or gravelly soils, can wash herbicides down to the mother tuber and result in damage to the crop. Metribuzin damage on seed crops can be confused with virus symptoms so it is best used pre-emergence on seed crops and its use on seed crops on light or stony soils should be avoided.

After application of residual herbicides the drill should not be disturbed for example by liquid fertiliser injection.

Residual herbicide options are:-

Linuron belongs to the same group of herbicides as Isoproturon, and like Isoproturon in cereals linuron was once the back-bone residual herbicide used in potatoes. Due to environmental fate issues, the rate of application allowed is now restricted to 600g ai/ha equivalent to 1.2lt/ha of a 500g ai/lt formulation. Linuron is now solely marketed by Makhteshim Agan (UK) Ltd. Linuron is now

commonly recommended as a mixture product with metribuzin. At 1.2lt/ha linuron strengthens control of annual meadow grass, polygonums, chickweed, fat-hen, mayweed and small nettle control in a metribuzin tank-mix. A linuron + metribuzin mixture would commonly be mixed with an appropriate contact herbicide such as diquat, carfentrazone or glufosinate ammonium to control any emerged weeds.

- Metribuzin is sold as a stand alone product as Sencorex by Bayer Crop Science and in many generic formulations but also in co-formulation with flufenacet as Artist, also by Bayer Crop Science. Metribuzin is from the triazine herbicide group and is replacing Linuron as the standard pre and early post emergence residual herbicide in potatoes. However metribuzin has variety and soil type restrictions and the product label, manufacturer and a BASIS registered agronomist should be referred to before application. For example the common variety Maris Piper is not tolerant to post emergence applications but can be used pre-emergence with Piper. Soils with high organic matter, (>10%) should use up to 1.5kg/ha using a pre-emergence incorporated programme. On sands the total dose should not exceed 1.0kg/ha and in reality lower rates are used. Metribuzin may be used pre-emergence on early varieties grown under plastic covers on tolerant varieties.
- The strengths of metribuzin include control of annual meadow grass, polygonums, cleavers, chickweed, volunteer rape and range of other broad leaved weeds. Metribuzin is commonly applied in tank-mix with a contact herbicide, as above or increasingly in a three way mix with linuron or mixed with prosulfocarb to boost polygonum weed control. (see below). Metribuzin can be used in a split low dose pre and post emergence programme, particularly useful where black bindweed is a problem weed. Black bindweed is best controlled by a post emergence application and in tank mix with rimsulfuron, (Titus, Tarrot). (Note that rimsulfuron should only be used on ware crops).
- Artist, as mentioned above, is a co-formulation of metribuzin + flufenacet. Flufenacet is most commonly found in cereal herbicides. In Artist it adds improved cleaver and grass weed control to metribuzin. As with straight metribuzin it is commonly used in tank-mix with a contact herbicide but is restricted to pre-emergence application, of the crop, and has the same variety restrictions as straight metribuzin.
- Defy, active ingredient prosulfocarb, belongs to the thiocarbamate group and is a relative new comer to potato weed control and can be used on all varieties of potatoes. It should not be used as a stand alone product. Its strengths are grass weeds, black night shade and cleavers but its control of polygonums such as knotgrass, redshank, mayweeds and fat-hen can be weak. It has some against fumitory, an increasingly important weed. It is recommended in mix with metribuzin or linuron, or a combination of the two to cover the full spectrum of weeds, plus a contact herbicide as listed above.
- Pendimethalin. Sold under a variety of generic formulations and strengths. The most recent are Cinder CS from Makhteshim Agan and Stomp Aqua from BASF. Both are capsulated suspensions, which are “cleaner formulation than the old yellow suspension concentrates. Pendimethalin must be applied 7 days before crop emergence. Avoid use on very light or gravelly soils as damage can be caused if there is heavy rain after application. Best mix with metribuzin to cover gaps in weed spectrum such as mayweeds and

cleavers. Do not use on seed crops as it can cause viral like curling of leaves.

- Gammit, active ingredient Clomazone. Clomazone’s strength is cleaver control with additional activity on chickweed and shepherd’s purse but it is weak on bindweed and redshank. It is viewed as a mixer product with other residuals such as metribuzin and linuron to cover the gaps in brassica and mayweed control and improve control of polygonums. Indeed it is now available in co-formulation with linuron as Lingo and with metribuzin as Metric, both from Belchim Crop Protection.

D. Post emergence products. Broad leaved weeds

The options for post emergence broad leaved weed control in potatoes are limited to:-

- Titus/Tarot, as rimsulfuron, a sulfonyl urea, is recommended for ware crops only or for uncertified dual purpose crops. Rimsulfuron controls the typical sulfonyl weed spectrum of chickweed, charlock, volunteer rape, mayweed, small nettle. It’s additional strengths are cleavers, small bindweed and fumitory but it is weak on fat-hen. Bindweed control can be improved by mixing with metribuzin, on tolerant potato varieties only. As a side benefit couch grass is suppressed.
- Basagran SG, active ingredient bentazone, will control seedling weeds up until the crop is 15cm tall. It is usually used in a programme with metribuzin and like metribuzin should only be used on named main crop and second early varieties, not seed crops. The strength of Basagran is control of chickweed, cleavers, brassicae weeds and small nettle but it is weak on the polygonums. Application should be avoided during periods of hot sunny weather or stressed crops suffering from weather or disease. An adjuvant such as Actipron is recommended but should not be used if the variety is only marginally tolerant. Before application check the label and get advice from a BASIS qualified agronomist.
- Metribuzin as mentioned in the pre-emergence section has a useful post emergence application, on tolerant varieties. It may be applied either as a split dose, pre-emergence and post emergence or as a single post-emergence application. The split dose is useful to control surface germinating weeds, eg. volunteer rape, which is often followed by a later flush or when targeting black-bindweed which is best controlled from a post emergence application.

E. Post emergence products – Grass weeds

There are a range of graminicides approved for grass weed control in potatoes, cycloxydim, quizalofop-p-tefuryl. and propaquizofop, Laser, Panerex and Shogun respectively. All three products have a range of rates dependant on the target grass weed. They are commonly used to suppress couch grass at the higher application rates, e.g. for Laser this is 2.25lt/ha. Timing of the application is usually dependant on the extent to which the crop covers the weed reducing coverage.

- **TAKE CARE WITH HERBICIDES ON AND AROUND SEED CROPS**
- **If in doubt about any product described in this technical note consult a BASIS qualified adviser**

F. Weed Spectrum of common residuals from pre-emergence application. A Contact herbicide would commonly be added to control emerged weeds

	Metribuzin Pre-em 1.0kg/ha	Linuron, Pre-em 1.2lt/ha	Artist 2.5kg/ha	Defy 4.0lt/ha	Gamit 0.25lt/ha	Defy 4.0lt + Linuron 1.2lt/ha	Defy 4.0lt Sencorex 0.5 kg/ha
AMG	****	***	****	****	***	****	****
LSB	****	*	****	****	R	****	****
A Nettle	****	**	****	****	***	****	****
B. Nightshade	R	*	**	****	**	****	****
B. Bindweed	**	**	**	**	***	***	**(*)
Chickweed	****	***	****	****	****	****	****
Charlock	****	****	****	****	*	****	****
Cleavers	*	**	***(*)	****	****	***	***
Creeping thistle	**	*	*	**	R	**	****
Cranesbill	R	**	R	****	R	****	****
Deadnettle	****	*	****	****	***	****	****
Fathen	***	***	****	**	**	****	****
FMN	****	***	****	****	*	****	****
Fumitory	***(*)	*	**	****	*	***	****
Groundsel	****	**	****	****	***	****	****
Knotgrass	***	**	****	**	***	***	****
Mayweed	****	***	****	*	*	****	****
Pansy	***	****	****	*	*	****	***
Pale persicaria	***	***	**	**	**	***	***
Redshank	****	***	****	**	***	***	****
Poppy	****	***	****	*	*	****	****
S.Purse	****	****	****	****	****	****	****
Speedwells	****	**	****	****	***	****	****
Sowthistle	****	**	****	****	***	****	****
V. Rape	****	***	***	**	*	***(*)	****
Small Nettle	****	**	****	****	***	****	****

Note AMG = Annual Meadow Grass, LSB = Loose Silky Bent
FMN = Forget-me-knot knot

**** 85 -100% control (S)

*** 75 - 85% control (MS)

** 60 - 75% control (MR)

* 0 - 60 % control (R or suppression of cotyledons only) G. Summary of Rates and Timings of Potato Herbicide Options

G. Summary of Rates and Timings of Potato Herbicide Options

Product	Recommended Rates	Timing	Comments
1. Contact Options			
Retro – Syngenta	2.0lt/ha	Earlies, Pre-em 10% emergence Main crop to 40%	A 4.0lt max rate has been applied for. Expected spring 2010. Weak on grass weeds at 2.0lt/ha
Shark- Belchim	0.33lt/ha	Earlies to 5% em Main crop to 10% em	Leaves at emergence will be burned off. No grass weed control
Basta – Bayer CropScience	2.0lt/ha	Pre-emergence of crop	Ware only. Broad spectrum Poor rain fast
Note Contact herbicide should be mixed with a suitable residual – see below			
2. Residual Options			
Linuron 50 SC – Makhteshim Agan (UK) Ltd	Max dose 600gai/ha 1.2lt/ha (50%)	Pre-em of crop	Needs a tankmix partner eg. metribuzin or Defy (prosufocarb) Good on polygonums
Metribuzin – Sencorex - Bayer CropScience Shotput - Makhteshim Agan (UK) Ltd	Earlies/Maincrop -Max individual dose 1.5kg/ha Main crop- Max total dose 2.0kg/ha	Pre-em or post emergence to before 15cm of growth	Note please check label and variety and soil type before application both pre and post emergence application. The max rate depends on soil type and variety, especially not post em on M. Piper
Artist – Metribuzin+flufenacet Bayer CropScience	2.5kg/ha	Pre-em of crop	Early and main crop. Not on piper on light/v light soils Broad spectrum
Defy - Syngenta	Max Dose 5.0lt/ha	Pre-em to soil rising over shoots	Typical dose 4.0lt/ha + linuron or metribuzin. Good on cleavers
Gamit - Belchim	0.25lt/ha	Pre-em – Before ridge cracking	Use specifically for cleavers and s.purse
Pendimethalin - Various	3.3lt/ha	Pre-em / Max 7 days before emergence	Best mix with metribuzin 0.5kg. Avoid gravelly or stony soils. Possible use under covers.
3. Post Emergence Options			
Tarot/Titus Makhteshim Agan (UK) Ltd	50gm/ha	Before crop 25cm	Ware only. Good on small bindweed, cleavers, typical SU weeds and suppression of couch grass
Basagran- BASF	3.0lt/ha	Before crop 15cm	Not on seed or earlies. Check variety of main crop or second earlies. Use in sequence of pre-em metribuzin. For fat-hen use with Actipron. Check label before use
Graminicides Laser BASF Falcon/Shogun	0.5lt – 2.25lt/ha 0.7lt – 1.5lt/ha	To before crop canopy prevents coverage	Rate is dependant on weed. Low rates for volunteer cereals. High rates for couch grass

H. Weed control in Organic Crops/Non chemical weed Control

Organic Potato Weed Control

Weed control in organic potatoes is possibly easier and less expensive than most other organic crops. This is due to the potatoes crop being able to create a very full canopy to smother weeds and a potato crop can withstand a lot of soil disturbance before emergence. It is not necessary to kill every weed in the field. The key to weed control is early action. A weed which is at cotyledon stage is more easily dislodged than a weed which has several pairs of true leaves. The early emerged weeds also give more competition to the crop than later emerged weeds. It is cheaper to have an extra weeding pass early than it is to try to deal with large weeds.

Crop Vigour

The first step to successful weed control in organic potatoes is having a competitive and vigorous crop which will create a canopy to shade out the weeds and create a root system which will compete strongly with weeds for water and nutrients. Careful field selection, variety selection and seed selection with the most emphasis placed on the fertility of the field and health of the seed is essential. If the crop is not vigorous whither due to poor fertility, poor cultivations or high levels of disease then weeds will take advantage and be expensive or difficult to control. To the uninitiated many organic crops are written off due to the inability to control the weeds but often the weeds are a secondary symptom of a poor crop.

Perennial Weeds

Established organic farmers have found that annual weeds are relatively easy to deal with but that perennial weeds such as docks, creeping thistles and couch grass increase gradually. These weed should be tackled at all stages in the rotation. One effective way of greatly reducing this problem in organic potatoes is to use a webbed destoner and bury the couch or docks in the stone row. Subsequent traffic up the beds prevents the emergence of the buried rhizomes. It is inevitable that some docks, couch or thistle rhizomes will be end up in the potato drills. Any growth which emerges before the potatoes emerge can be burnt off with a gas burner. This will only suppress a perennial weed but is important and does reduce the weed competitiveness. Prior to harvest when the crop is senescing couch in particular will keep growing. Although this will not reduce the gross yield of potatoes it will cause quality and harvesting problems. Couch rhizomes can grow into the potato tubers making holes which can be mistaken for wireworm damage which can result in the rejection of whole fields by packers. Couch will also increase the difficulty of getting good separation at harvest. Increasing agitation to remove couch rhizomes can also increase tuber damage.

Annual Weeds

Generally these are easily controlled using any of the following methods as long as there is early intervention.

Different Methods Of Weed Control

There are many techniques which can be used to control weeds in organic potatoes. Usually a combination of two or three methods give

the best results. Some operations are specifically for weed control others help contribute to better weed control.

Gas Burning

Gas burners only control weeds which have already emerged. Small weeds are more easily controlled than large weeds and broadleaved weeds are more easily controlled than grass weeds. There are several gas burners available up to 6m wide. It would be expected to use 50-80litres of gas per hectare per pass. A 2m wide gas burner can cover about 1ha per hour depending on the size and species of weed. The gas burner can be used pre crop emergence and to desiccate the crop pre harvest. They provide the only way to control weeds growing on the drills preharvest as mechanical weeders would damage potatoes close to the surface.

Cost £55/ha per pass

Mechanical weeders

Mechanical weeders control weeds which have germinated but not emerged as well as emerged weeds. There are many types of brush weeders, tined weeders and other steering hoes on the market. Generally these knock down and then build up the ridges. Each has its own strong points and weak points the best choice will depend on the other crops on the farm, target weeds and soil type. Whilst damage to crops with weeders should always be avoided potatoes are quite robust and can withstand quite vigorous weeding. Mechanical weeders will encourage some mineralisation of soil nitrogen which may be beneficial for crop growth.

Cost £30/ha per pass

Plastic mulches

Black plastic mulches can be laid on the drills after planting. The mulches are removed when the potatoes emerge and start to push up the plastic. Any weeds which emerge die due to lack of light or are greatly weakened and more easily killed by mechanical weeders or gas burners immediately after the mulches are removed. The process of laying the plastic and then removing it is time consuming and requires more specialised equipment. The mulches also warm the drills up quicker and promotes the growth of the potatoes which may be beneficial. Disposing of the plastic to landfill is an environmental concern and doesn't quite fit the organic ethos. For commercial potato crops this method is unlikely to be economic.

Cost £500/ha

Rouging and Handweeding

If other methods of weed control allow some trouble some weeds to sneak through then hand rouging or hoeing can be undertaken. Realistically in a potato crop this will be limited to wild oats or some perennial weeds.

Cost £0 - £500/ha

Destoners

The primary reason for destoning is to separate stones and clods from the soil. However destoning offers a chance to control perennial weeds. Having a well setup webbed destoner will help bury most couch, thistle or dock rhizomes into the stone row.

Programme Of Weed Control In Organic Potatoes

Pre planting

Destoning with webbed destoner to bury couch, dock and thistle rhizomes into the stone row

Pre crop emergence

Mechanical weeding with brush weeder, tines or other interrow cultivator or gas burning

Post crop emergence

Mechanical weeding with brush weeder, tines or helistone rollers final pass when crop meets in the row

Preharvest

Flail

Gas burn if drills start to greenup with weeds especially annual meadow grass and couch

References

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