



Assured Crops

Crop Specific Protocol

SWEETCORN

(CROP ID: 30)



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Acknowledgements

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Preface

This crop specific protocol has been written to complement and avoid duplicating the generic principles of the scheme and appendices.

It is advisable to read the Assured Produce Generic Crop Protocol Standards and the Assured Produce Generic Protocol Guidance Notes (referred to in this document as the Generic Standards and Generic Guidance Notes) first before reading this crop specific protocol.

This protocol is designed to stimulate thought in the mind of the reader.

This crop specific protocol contains crop specific parameters and guidance, where applicable, for the requirements stated in the Generic Standards.

All statements in this protocol containing the words "**strongly recommended**" (in bold type) will be verified during the Assured Produce assessment and their compliance will form a part of the certification/approval decision. The score required for these "**strongly recommended**" control points can be found on the final page of this document and in the checklists produced by Assured Produce licensed certification bodies.

Disclaimer and trade mark acknowledgement

Although every effort has been made to ensure accuracy, Assured Produce does not accept any responsibility for errors and omissions.

Trade names are only used in this protocol where use of that specific product is essential. All such products are annotated[®] and all trademark rights are hereby acknowledged.

Notes:

Pesticides with 'Essential Use' derogations that expired 31 December 2007 can no longer be used or stored.

There may be other withdrawals or revocations. Products containing substances which have been revoked are shown on the PSD website (<http://www.pesticides.gov.uk>). Growers should check with their advisers, manufacturers, the Assured Produce website 'Newsflashes', the PSD website (www.pesticides.gov.uk)

Growers should comply with the 'Use up by' dates for all pesticide products. Growers should also be aware of and comply with changes on new product labels.

There may be changes for the following reasons:

- the deadline for use of NPE formulations has been extended to 31 August 2008, see <http://www.pesticides.gov.uk/approvals.asp?id=2122>
- Pesticides with NPE formulations must be used up by 31 August 2008. In many cases products will be replaced by new non-NPE formulations.
- At re-registration stage after Annex 1 listing there may be: reductions of dose rates; changes in timings and/or number of applications for some products.

In the following Appendices products and use by dates are only listed for SOLAs, and in some cases new product MAPP numbers may not be available yet.

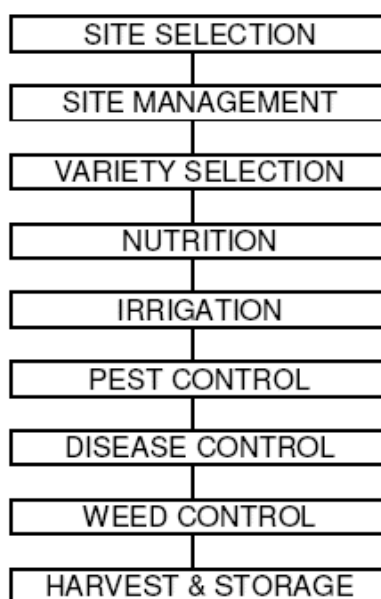
For pesticides on-label, only active substances are shown.

Any new standards have been prefixed in the text with **(NEW)**

1 General introduction

Following a systematic approach will help growers to identify and manage the risks involved in crop production. This protocol is based on a typical crop production process. Using a flowchart approach, food safety, Health & Safety, environmental and quality hazards are identified. Appropriate controls may then be established to minimise risk. Food safety and Health & Safety issues always take precedence over quality and environmental controls.

The flow chart is structured as shown below. Note that the sectional layout of both this protocol and the crop specific protocols follow the same structure.



The contents of each crop specific protocol are reviewed annually by informed farmers and growers, food technologists, scientists, the relevant fresh produce association, processors and agronomic consultants. Updated editions are issued prior to the cropping season.

The review process considers both new developments and all relevant technology which has emerged throughout the course of the previous year and which have been found to be both workable by the grower and beneficial to the environment. As one aim of the Scheme is to transfer such information and technologies to growers, attention is drawn to those features of specific relevance to ICM by using *italic* script. In order that growers may be confident that they are working to a current document, each protocol is dated and numbered.

2 Planning and records

See Generic Standards and/or Generic Guidance Notes.

3 Site selection

3.1 Site History

With a crop such as Sweetcorn (*Zea mays* var. *saccharata*) as the crop gets further away from ideal growing conditions so the inputs needed to bring the crop to successful maturity increase disproportionately.

Product type, geographical position, site selection, aspect, previous cropping, weed spectrum, soil type, tilth

and irrigation potential all play a critical part in the production of the crop. Compromising on any one of these husbandry elements almost certainly leads to unnecessary crop inputs and may compromise the principles of ICM.

Sweetcorn will always perform better on a south facing aspect, protected from wind and frost. Cold, exposed sites are generally unsuitable for the production of the crop. Sites prone to flooding, high winds and frost should be specifically avoided.

3.1.1 Geographical location

In general terms, the further north that Sweetcorn is grown in the UK the shorter the season and the less likely production will be successful. This is especially true for supersweet Sweetcorn varieties.

Although there are a few exceptions, the main commercial Sweetcorn production areas are located in the south and southeast, positioned geographically below Cambridge.

3.1.2 Endemic weed spectrum

This is a critical aspect in choosing suitable land for cropping because Sweetcorn cannot tolerate weed competition. Weeds, such as members of the *Polygonaceae* and *Solanaceae* families and couch (*Elymus repens*), present particular control problems so fields infested with such weeds should be avoided as much as possible.

3.1.3 Soil type and tilth

It is important that the suitable soils are chosen and the correct tilth achieved prior to drilling. Heavy, cloddy soils are generally unsuitable for the successful establishment of the crop. Soils that are prone to capping, which interferes with emergence, are generally unsuitable for the low vigour supersweet varieties.

Supersweet varieties especially can be classed as poor vigour varieties and poor soil friability adversely affects establishment of such varieties.

In general terms, Sweetcorn drilled in land prepared immediately after an overwintered crop such as cabbage, is likely to be less successful than Sweetcorn drilled in land with a good frost tilth which has been left fallow during the preceding winter.

3.2 Rotation

Sweetcorn can be planted in successive years, but this should be discouraged if successful production is to be maintained.

Successive crops can lead to a rapid build-up of difficult to control weeds, particularly Black Nightshade (*Solanum nigrum*). Sweetcorn following forage maize should also be discouraged and, if possible, Sweetcorn should not follow pasture because wireworm (species of the families *Elateridae* and *Tenebrionidae*) problems may occur.

Sweetcorn that follows tuber crops, such as potatoes, is likely to be at risk from the competition from the volunteer re-growth of the tuber crop.

4 Site management

4.1 Soil mapping

See Generic Standards and/or Generic Guidance Notes.

4.2 Soil management

Ground preparation and early 'pest' prevention

Ground preparation should, wherever possible, follow an overwintered frost-conditioned fallow. Whilst not practical in early-drilled crops, the early preparation of land can lead to a heavy flush of weeds emerging just prior to drilling. A well-timed non-selective herbicide will obviate the need or reduce the rate of subsequent selective herbicides in the crop.

Soils that tend to slump are not generally suitable for this 'stale seedbed' approach. The choice of equipment for ground preparation lies with the grower.

Prevention of pest damage starts at this point as the early cultural control of weeds prevents any chance of re-seeding. Cutworms (*Agrotis* spp.), the caterpillars of several species of noctuid moths, are more likely to be a problem in lands where large-sized weed cover precedes last minute ground preparation. Cutworms not only graze at the base of the plant but also invade the developing leaf funnel, ultimately causing plant death.

Slug monitoring should be carried out prior to drilling the crop. Slugs (*Derocerus* and *Milax* spp.) are not usually a problem in the lighter soil types more suited to Sweetcorn production. However, in fields where slugs are an historical problem or where growers have no historical data, covered slug monitoring traps set prior to the drilling of the crop can indicate whether control measures are warranted prior to seeding or whether an alternative site would be more suitable.

4.3 Soil fumigation

See Generic Standards and/or Generic Guidance Notes.

4.4 Substrates

See Generic Standards and/or Generic Guidance Notes.

4.5 Drilling and transplanting

4.5.1 Drilling

Successful crops are usually drilled between the first week of April and the first week of June. The most important criteria for the successful establishment of the crop is a soil temperature (at 5 cm) of at least 12°C and no frosts during the early development of the plant.

Seed rates and seed spacings are at the discretion of the grower and are dictated by variety, potential cob size and market requirement. Usual seed rates lie between 45,000 and 65,000 per hectare. Planting depth should be in accordance with moisture reserves and soil temperatures, but Sweetcorn rarely emerges well from deep drilling depths.

Transplanting modular transplants or blocks is not recommended as it rarely results in a successful crop. The crop development is usually promoted through the use of ground mulches through which the seedlings grow. These mulches are usually laid down at the time of drilling and are designed to remain until after harvest. Mulches that are biodegradable either through the action of sunlight or through moisture are recommended. It is **strongly recommended** that if non-biodegradable mulches are used, they are recycled or disposed of in a registered landfill site. The benefit to the crop is in its earlier stages of growth where the mulch's soil warming properties increase the seedlings' rate of development to the young plant stage. This generally results in both yield increases and an earlier maturity. Floating mulches, which are removed as the crop grows, are also used.

If the grower elects to use either biodegradable mulches or floating mulches then the application of residual herbicides needs to be made prior to or immediately after (pendimethalin), drilling. However, the need for residual herbicides may have been obviated by a successful stale seedbed technique.

4.5.2 Growth stages

Once emerged, the plant passes through two distinct stages i.e. vegetative and reproductive. Each vegetative stage is subdivided into 'V' stages where each stage is an unfurled leaf. There can be up to 18-20 'V' stages before tasselling occurs. The plant moves from the vegetative stage into the reproductive stage 'R' in a few days. In the UK, tasselling takes place around 75 days after drilling.

5 Variety selection

There are several types of Sweetcorn that can be grown in this country but the main types include the normal endosperm or supersweet (SH₂ shrunken). Varieties can be yellow, white or bi-coloured.

Supersweet Sweetcorn now accounts for the majority of the UK hectareage. It differs from the more traditional normal endosperm Sweetcorn in its characteristic sweetness after picking. It usually stays sweeter much longer after picking because of a very slow and limited conversion of sugars to starch. This limited conversion can also be visible in the seed because the lack of starch gives the seed a shrivelled or shrunken appearance.

Bi-coloured Sweetcorn is usually a supersweet variety. They are characterised by an almost random white and yellow kernel configuration on the cob. Other Sweetcorn types that can be grown in the UK include white (normal and supersweet), sugary enhanced and multi-coloured (ornamental).

It is **strongly recommended** that when choosing a sweetcorn variety the soil type, fertility, soil temperature characteristics, shelter and irrigation potential of the proposed site are taken into consideration, as well as the requirements of your end customer.

6 Nutrition

With the exception of Nitrogen, the application of nutrients should be largely undertaken preplanting. Nutrient application should be made in accordance soil analysis results. In practice, even though mineral nitrogen can be assayed, the test is currently disproportionately expensive and the results difficult to link to objective nutritional recommendation.

In the case of Nitrogen, only low levels of Nitrogen are used by the crop between germination and the V6 stage. Therefore in Nitrate Vulnerable Zones, or soils prone to leaching, it may be more prudent to apply low levels of Nitrogen to the seedbed, with the balance being applied between the V4 and V6 stage.

Clearly as more research is conducted, the correlation between mineral nitrogen testing and nitrogen fertiliser recommendation will become more straightforward. Advice on the interpretation of analysis and the recommendation of nutrition should, wherever possible, be taken from a FACTS-certificated advisor.

The Sweetcorn plant can be very sensitive i.e. any part of the plant touched by solid (prilled or pelleted) nitrogenous fertiliser will usually die. It is therefore essential that any top dressing is carried out before the plant has reached a size where prills can lodge inside the developing plant. Other suitable methods of fertiliser application include placement top dressing, soil injection, foliar feeds and fertigation.

In a healthy vigorous plant, there are only a limited number of agronomic problems with which to contend. Where fertilisers have been applied in part to the seedbed, pending further applications, the timings of the subsequent applications can be crucial. These depend greatly on the rate of the crop's development; however, all nutrition should be applied before growth stage 'V8'.

Microelements such as boron, zinc, manganese and iron, are all important for the successful growth of the crop. These elements should be applied according to analysis results or to correct deficiencies visible as leaf symptoms.

Sweetcorn will not tolerate an unsuitable pH. Growers should react to soil analyses and target for a pH of 6.5.

7 Irrigation

Sweetcorn must never be allowed to dry out. Class 1 produce cannot be achieved if the crop is allowed to become moisture stressed. If the local rainfall and the moisture holding properties of the soil are likely to cause the crop to become moisture stressed, irrigation must be available.

Irrigation on crops in lands prone to moisture stress is desirable throughout the vegetative growth stages. Although the plants should never be allowed to dry out, irrigation should be kept to a minimum to encourage full root growth potential. SMD can be objectively determined as part of an integrated approach to irrigation.

Irrigation can also play an important role in pollination and the subsequent development of the cob. Those plants that become dry during pollination will never set a full cob and will not achieve Class 1 status even though there may be enough moisture available during kernel swelling.

After pollination has occurred, the cob will take around 25 days to mature. Correct watering plays an important part in the development of the cob to its full potential as cobs are harvested at an appropriate stage of ripeness according to the proposed date of final produce marketing.

8 Crop protection

8.1 The basic approach to crop protection

8.1.1 Non-chemical methods

See Generic Standards and/or Generic Guidance Notes.

8.1.2 Integrated crop management

- Pick the Sweetcorn type(s) required by your markets.
- If more than one type is chosen, be sure to fully separate the types by at least 500 m if pollination timings are set to coincide.
- Select the correct fields using the following criteria: - aspect, soil type, previous cropping, soil condition, protection, irrigation potential and weed spectrum.
- If possible, make up seedbeds in advance to achieve a stale seedbed thus potentially reducing herbicide usage.
- Apply a proportion of the fertilisers to the crop after emergence.
- On fields prone to slugs, set traps to evaluate slug populations. If populations are high aim to find another field. Failing this, apply baits in advance of drilling to minimise crop damage.
- When drilling a mulched crop, assess the likely weed spectrum and choose, if necessary, the most suitable residual herbicide. Avoid choosing a 'Red List' chemical unless absolutely necessary.
- It is **strongly recommended** that *Phacelia tanacetifolia* is drilled in blocks within the crop so as to attract Aphid predators into the crop at the critical infestation time.
- In frit fly prone areas, grow the crop away from grass headlands or cereal crops.
- Crops, which are fully covered as opposed to those where the plants grow through the mulch, should be fully protected against egg-laying adult cutworms and no subsequent control measures should be required.
- In non-mulched crops, wait for weeds to emerge then select the most suitable herbicide. If a 'Red List' chemical is chosen, follow the label recommendation and protect watercourses. Actively seek to reduce

the risk of 'run-off' into watercourses.

- Field inspections should be carried out prior to the emergence of the tassel spike to assess for aphids. If necessary, treatment should be with a predator-friendly product such as pirimicarb.
- If feasible, the final nutrient application should be applied prior to growth stage 'V8'. Take care not to touch the foliage with the fertiliser.

Continue to make field inspections throughout the life of the crop. The critical time for aphid infestation is at tassel development. Assess aphid numbers, the numbers of actively feeding predators, and then choose the most suitable form of control. Aim to preserve predators if your objective assessment indicates a satisfactory predator prey ratio. Treatment with a non-predator friendly insecticide should be made only when bees, attracted to the *Phacelia*, are not foraging in the crop i.e. late evening.

8.2 Plant protection product choice

See Generic Standards and/or Generic Guidance Notes.

Approved uses not included on the product label

In some circumstances product labels do not include all of the approved uses and growers and advisers wishing to check the approval notice of a particular product should note that this information is available from www.pesticides.gov.uk/psd_databases.asp

A search on the database for a product name should yield a results page. A click on the product name should link to a summary of the approval information. At the bottom of the summary are links to available notices which will give the statutory conditions of use.

In the case of products with older approval an electronic approval may not be available. In these cases growers should contact the PSD Information Services Branch for details of the approved conditions of use.

Contact details are: p.s.d.information@psd.defra.gsi.gov.uk tel. 01904 455 775.

8.3 Advice on the use of pesticides

See Generic Standards and/or Generic Guidance Notes.

8.4 Application of pesticides

See Generic Standards and/or Generic Guidance Notes.

8.5 Records of application

See Generic Standards and/or Generic Guidance Notes.

8.6 Protective clothing/equipment

See Generic Standards and/or Generic Guidance Notes.

8.7 Pesticide storage

See Generic Standards and/or Generic Guidance Notes.

8.8 Empty pesticide containers

See Generic Standards and/or Generic Guidance Notes.

8.9 Pesticide residues in fresh produce

See Generic Standards and/or Generic Guidance Notes.

See Generic Protocol Guidance Notes 8.9 for further background and generic advice .

Assured produce is aware that a key area in the production of fresh produce which requires continued attention by growers and their advisers is that of keeping pesticide residues to a minimum. The issue is not just one of meeting the MRL trading standard but ensuring that any individual or multi residues are kept as low as possible below this level.

The key targets are:

- **Optimising late application of fungicides and insecticides to the edible part of the crop**
- **Optimising the use of post harvest treatments**
- **Ensuring minimum harvest intervals are followed**
- **Ensuring that application equipment is applying products correctly**

Currently there are no residue issues with this crop but the awareness needs to be maintained for any future issues

8.10 Pest, disease and weed control

8.10.1 Pest control

8.10.1.1 Frit fly

The frit fly (*Oscinella frit*) attacks the developing seedling and destroys the growing point. Heavy infestations can destroy the majority of a crop.

Frit fly is rarely controlled once the symptoms of the attack are visible and plants, which remain untreated until damage is seen, rarely produce a marketable cob. Whilst there is a specific off-label approval for the use of Hallmark, the use of this product should not be relied on to give complete control of frit fly and cultural methods should be employed to reduce the likelihood of damage. Maggots overwinter in grasses or cereal shoots, pupating in March or April and giving rise to the spring generation of flies. Grass weeds will generally be the main source of the pest and areas with headlands with a high level of grasses should be avoided. Selecting growing sites away from cereal crops is also recommended.

The plants are usually only susceptible up to the v3 - v4 growth stage and therefore every effort should be made to encourage the crop to develop quickly at this stage to outgrow the pest.

8.10.1.2 Aphids

Further pest problems prior to tasselling are rare and do not usually result in an economic yield loss. Aphid infestations, however, are an exception having an adverse effect on the crop throughout its life. In the vegetative growth stages, the pest can both stunt the crop and be a vector for virus infection. The feeding habit of the aphids can introduce fungal spores into the plant. The threshold levels for aphid treatments are vague, however, if field inspections reveal consistent aphid presence on most plants examined treatment should be made.

During the reproductive growth stages, the crop becomes highly susceptible to aphids. Many species infest the plants, but one species, the bird cherry aphid (*Rhopalosiphum padi*), is responsible for most of the damage. Other species include the grain aphid (*Sitobion avenae*) and the cereal leaf aphid (*Rhopalosiphum maidis*).

Aphid damage results from the complete covering of the tassel preventing the release of pollen. This followed by the aphids migrating down to the developing cob. The cob is then usually smothered in aphids, all producing honeydew that supports the growth of sooty moulds. A cob can be rendered unmarketable by both aphids and moulds within the three to four week period of cob filling, so aphid infestations at tasseling must be controlled.

Infestation is sometimes linked to the ripening of surrounding cereal crops and the need for the aphids to find an alternative food source. The level of infestation can often be correlated to the level of control achieved on local cereal crops. Traditionally, the pest is present in greater numbers on Sweetcorn if there have been little or no control measures taken on cereals.

8.10.1.3 Cutworms

As there are no chemical means of control for Cutworm, crops should be monitored closely for activity. The pest can be suppressed if it coincides with a period of heavy rain or heavy irrigation, therefore irrigation can be used as a cultural means of control.

Other pests

Earworms (*Heliothis zea*) are an occasional pest in the UK. A devastating pest of Sweetcorn in other parts of the world, it is only rarely of economic importance in the UK. However, one should evaluate the value of pheromone trapping based on geographical location and previous pest history. If adults are found, or there is the presence of eggs on the silks of the ears, then growers can elect to use either the SOLA for *Bacillus thuringiensis* var *kurstaki* or the SOLA for Steward (a.i. Indoxacarb).

Very occasionally crops can become infested with earwigs. Control measures are not warranted.

8.10.1.4 Companion cropping

Those predators, which help reduce aphid numbers, can be attracted into the crop by the companion plant *Phacelia tanacetifolia* , which may be either sown later in blocks within the crop or around the periphery of the crop if sufficient area of cropping land is left. As *Phacelia* takes approximately 45 days to flower, it should be sown so that flowering coincides with the tasselling stage of the Sweetcorn. *Phacelia* will not tolerate herbicides approved for Sweetcorn.

The flower of this plant attracts various beneficial insects including hover flies, ladybirds, lacewings and parasitic wasps. The most important is the hover fly. The larvae of this dipterous fly are predators of aphids and thus *Phacelia* is often used as part of an integrated control programme for aphids.

8.10.1.5 Molluscs

Slugs (*Derocerus* and *Milax* spp.) which have not been controlled prior to drilling may cause problems to the emerging plants by shredding firstly the leaves and subsequently the growing point. Heavy infestations need to be controlled at this stage if the crop is to reach maturity. Later infestations, when the plants are larger, rarely warrant control.

Slug monitoring is an important part of slug control. Baits applied to a small area and then covered to prevent vertebrate animals eating any of the dead molluscs, provide a good way of monitoring activity prior to drilling the crop. Depending on the catches, growers can take no action through to the application of pellets prior to

drilling (especially important in the mulched crop), or even choosing another field.

There is a limited choice of active ingredients for the control of slugs in Sweetcorn but a wide choice of products. Growers should elect to use those products that are formulated to provide good longevity. Control in the crop is usually only warranted at the seedling stage.

8.10.1.6 Foliar applied insecticides

Primary aphid infestation control is important for the control of virus particle transmission and the prevention of the introduction of fungal spores into the plant.

Whilst there are a number of approved treatments, growers should look to control aphids at this stage. There are products containing pirimicarb which have both full and off-label approval. Growers should take account of the maximum number of treatments allowed and the minimum harvest intervals stated in the SOLA 'notice of approval' document. The efficacy of pirimicarb-based products can be enhanced by the addition of an oil into the tank mixture. A recent addition to the range of aphicides is the product Plenum, active ingredient pymetrozine. This chemical has a novel mode of action as it blocks the stylet of the feeding aphid. With late heavy infestations there are two courses of action open to growers. The first is to continue with either Pirimicarb or Pymetrozine-based products. With Pymetrozine it is important that the harvest interval can be observed. Growers may also elect to use the nicotine-based product Nicosoap. This is not a systemic product, but will achieve good aphid control if applied evenly to cover all the infested areas of the plant. This product can also be used to control aphids resistant to carbamates.

For the control of earworms (*Heliothis zea*) if shown to be necessary, there is now a specific off-label approval for the use of either Hallmark[®] or Hero[®] or Dipel. As with all specific off-label approvals, a copy of the relevant SOLA is required to use either of these products. Application should be made when appropriate thresholds are exceeded.

8.10.2 Disease control

The diseases of Sweetcorn are rarely worth treating and as such there are no fungicides approved for use in the UK.

The most common disease is common smut (*Ustilago zaeae*) which manifests itself as silver galls filled with black smut, bursting out of those parts of the plant where rapid cell division occurs. The disease will also infest the cobs, rendering them unmarketable. There is no means of controlling this disease once it has started to develop.

Common maize rust (*Puccinia sorghi*) is occasionally seen in the UK, and over recent years has become more prevalent. The disease can be of economic importance as the rust pustules mark the sheath of the cob making them unsightly and potentially unmarketable. There are a number of rust resistant varieties now available in the UK and these should be evaluated for inclusion in a grower's range of varieties.

Maize Eyespot is a disease which has been seen occasionally over the last few seasons in the UK. Caused by the fungus *Aureobasidium zeae* (previously known as *Kabatiella zeae*). Symptoms occur primarily on older leaves, the initial symptoms being small, water soaked or chlorotic circular spots. The tissue at the centre of the spot later dies. The spot is surrounded by a yellow halo that can be seen clearly when the leaf is held up to the light. Spots may coalesce into large necrotic areas and the entire leaf dies. These symptoms can be confused with physiological leaf spots.

Very little is known about this disease in the UK and how common it is. Severe outbreaks have been reported in the UK, with complete failures in effected crops. The disease overwinters in crop debris and its development is favoured by wet weather. The disease is much more common when corn follows corn; therefore good crop rotations should be practised to avoid the build up of this disease.

8.10.3 Weed control

Sweetcorn is also extremely poor at competing with weeds thus, if no herbicides have been applied pre-emergence; some form of weed control is normally warranted. In some situations, further, secondary, weed control will also be required. Herbicides can be categorised into three major categories i.e. contact and residual, contact or translocated.

In non-mulched crops, weed control timing is flexible as certain approved herbicides afford the grower an opportunity to wait for weed emergence, choose the correct herbicide and identify the weeds.

Some weeds, such as members of the *Solanaceae*, are resistant to some of the approved herbicides and this must be taken into account when choosing an appropriate herbicide. All weeds must be controlled if the crop is to reach a successful maturity.

Atrazine use

Atrazine has traditionally formed the backbone of weed control in Sweetcorn crops. However due to environmental concerns, particularly its ability to leach into watercourses, Atrazine usage has been revoked across Europe and must not be used in the production of Sweetcorn.

8.10.3.1 Pre-drilling herbicides

The choice is dependent on developing weeds. Flushes of annual weeds can be controlled by contact herbicides containing mixtures of paraquat and diquat, or products containing glufosinate-ammonium. Weed flushes consisting of both annual and perennial weeds can be treated with a systemic herbicide containing glyphosate.

The destruction of weeds pre-drilling is a sensible ICM approach.

8.10.3.2 Soil-acting residual herbicides

Selective herbicides approved for use in Sweetcorn can cause scorching in some varieties and at the very least delay maturity,

Growers can use the SOLA's for Calaris, or Callisto. Calaris is a mixture of Mesotrione and Terbutylazine, Callisto contains only Mesotrione. Currently it is recommended that these products are applied post-emergence.

For crops grown under plastic mulches, it is advisable to use a Pendimethalin based product, for the control of early weeds, prior to cover removal. This product is approved only in crops grown under crop covers and mulches and should be applied post-drilling, but pre-crop emergence. Using pendimethalin may mean modifying the normal mulch laying techniques.

In crops where mulches have been removed, or where no mulches were used, growers can elect to destroy weeds post-emergence.

Currently there has been no specific research carried out in the UK to establish the potential phytotoxicity of products containing Mesotrione ie Calaris or Callisto if used pre-emergence. There has been work carried out on Maize and Sweetcorn overseas, however there is none specific to the UK. Therefore it is strongly recommended that growers should not use these products without carrying out their own trials to establish potential phytotoxicity and to establish acceptable dosage rates. Whilst Atrazine is still approved for use until 30th June 2007, growers should use this product, whilst carrying out small scale field trials to understand the suitability of these products for use pre-emergence.

8.10.3.3 Post-emergence herbicides

With the addition of new herbicides, growers now have a broader range of active ingredients to choose from.

Where Solanaceae or Chenopodiaceae weeds are growing in the crop, growers can elect to use products containing bromoxynil. These are primarily contact herbicides in their mode of action and under certain conditions may scorch the crop. Alternatively growers can use product containing both bromoxynil and terbuthylazine.

Specific weeds of the Compositae family, such as thistles (*Sonchus* spp. or *Cirsium arvense*), need to be controlled in the crop often by spot treatment with products containing clopyralid. However the use of clopyralid can also restrict the planting or drilling of future crops both in the autumn and spring following the application. Applications of clopyralid can also control/suppress groundsel (*Senecio vulgaris*) and mayweeds (*Chamomilla* spp, *Anthemis* spp, and *Matricaria* spp).

Growers can also use the nicosulfuron based product, Samson, which has a specific off label approval for Sweetcorn. This provides control of a range of broadleaved weeds and some grass weeds. It can be used on the crop up to the 8 true leaf stage.

Other active ingredients available to growers for weed control are as follows:-

Callisto (a.i Mesotrione) has good efficacy on a wide range of weeds, including a number of problem weeds in Sweetcorn, namely Fat Hen, Black Nightshade and certain Polygonum species weeds.

Alternatively growers can choose Calaris, which is a mixture of Mesotrione and the triazine herbicide Terbuthylazine. This can increase the efficacy of control on Black Nightshade, Chickweed and Shepherds purse.

Specific Off Label Approval has also been granted for the use of Starane 2 (a.i. Fluroxypyr). Starane controls a range of problem weeds in Sweetcorn, including Black Bindweed, Knotgrass and Cleavers, however it also gives good control of volunteer potatoes.

9 Harvesting and storage

See Generic Standards and/or Generic Guidance Notes.

10 Pollution control and waste management

See Generic Standards and/or Generic Guidance Notes.

11 Energy efficiency

See Generic Standards and/or Generic Guidance Notes.

12 Health and Safety

See Generic Standards and/or Generic Guidance Notes.

13 Conservation

See Generic Standards and/or Generic Guidance Notes.

Appendix 1 Typical application rates for nutrients

Major nutrient requirements (kg/ha)	Soil Index				
	0	1	2	3	3+
Nitrogen (N)	150	100	50	0 ^(a)	0 ^(a)
Phosphate (P ₂ O ₅)	175	125	75	25M	0
Potash (K ₂ O)	250	200	150 (2-) 100M (2+)	0	0
Magnesium (Mg)	150	100	0	0	0

Notes:

The recommendations assume overall application. A starter fertiliser containing nitrogen and phosphate may be beneficial.

(a) A small amount of nitrogen may be needed if SMN levels are low in the 0-30cm of soil. Apply no more than 100 kg/ a N in the seedbed. Apply the remainder as a top dressing when the crop is fully established.

M Maintenance dressing

Do not forget to deduct nutrients applied as organic manures.

Appendix 2 Plant protection products approved for use on Sweetcorn

Active Ingredient	Approval Type	SOLA No	Max Dose	Harvest Interval ⁽¹⁾	Max No of Applications	MRL (mg/kg)
bacillus thuringiensis var kurstaki	SOLA	20071289	1kg/ha	N/A	N/A	None set
bromoxynil	SOLA	20071907	2.5 l/ha	none stated	none stated	none set
bromoxynil and terbuthylazine	SOLA	20072140 20072178 20072179 20080279	1.65 l/ha	Upto and including 8 true leaves	none stated	0.02 terbuthylazine
glufosinate-ammonium	Full	N/A	3.0 l/ha	pre-crop emergence or pre-planting	1	none set
lambda cyhalothrin	SOLA	20063760 20071289 20060732 20080203	50 ml/ha	7 days	150 ml/ha of product per crop	0.05
mesotrione	SOLA	20051893	1.5 l/ha	Upto and including 8 true leaves	none stated	0.05
mesotrione and terbuthylazine	SOLA	20051892	1.5 l/ha	Upto and including 8 true leaves	none stated	0.05 Mesotrione 0.02 Terbuthylazine
metaldehyde	Full	N/A	15 kg/ha	N/A	none stated	none set
nicosulfuron	SOLA	20072177	1.5	Upto and including 8 true leaves	none stated	none set
nicotine	Full	N/A	670 ml/ 100 l water	2 days	N/A	none set
paraquat and diquat	Full	N/A	5.5 l/ha	pre-crop emergence or pre-planting	1	Both 0.05 (LOD)
pendimethalin	SOLA	20042305 20052206 20052022 20062357 20062105 20071435	5 l/ha	pre-crop emergence.	1	0.05 (LOD)
pirimicarb	Full	20011298	280 g/ha	14 days	see label	none set
	SOLA	20051746		3 days	5	
pymetrozine	SOLA	20041318	0.4 kg/ha	14 days	0.8 kg/ha of product per crop.	0.02 (LOD)

Notes:

(1) or latest time of application

Not all products containing the above active ingredients may be currently approved for use on Sweetcorn. Label recommendations are revised regularly, read a current label before use.

Appendix 3 Specific off-label approvals

Number	Product Name	Active Ingredient	MRL (mg/kg)
20071907	Alpha Bromotril P [®]	bromoxynil	none set
20072140	Alpha Bromotril P [®]	bromoxynil & terbuthylazine	0.05 terbuthylazine
20062357	Alpha Pendimethalin	pendimethalin	0.05
20011298	Aphox [®]	pirmicarb	none set
20062105	Bunker	pendimethalin	0.05
20051892	Calaris	Mesotrione & Terbuthylazine	0.05 0.02
20051893	Callisto	Mesotrione	0.05
20012354, 20052022	Claymore [®]	pendimethalin	0.05
20051361	Clayton Lanark	lambda-cyhalothrin	0.02
20072178	Cleancrop Amaize	bromoxynil & terbuthylazine	0.05
20071289	Cleancrop Silo	lambda-cyhalothrin	0.02
20070432	DiPel DF	bacillus thuringiensis var kurstaki	
20072968 20072177	Samson [®]	nicosulfuron	none set
20052206	Sovereign 400 SC [®]	pendimethalin	0.05
20071435	Steward	indoxacarb	0.02
20072179 20080279	Templer	bromoxynil & terbuthylazine	0.05 terbuthylazine

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Appendix 4 Control Points: Sweetcorn

CS.30 SWEETCORN

- CS.30.1 You should match your chosen variety growing characteristics to the growing site, assessing soil type, friability, soil temperature characteristics, shelter and irrigation potential - Protocol reference: Section 5
- CS.30.2 If growers are not using biodegradable mulches, they should be able to demonstrate an efficient method of mulch retrieval and subsequent recycling - Protocol reference: Section 4.5.2
- CS.30.3 Deleted 2008
- CS.30.4 Growers should sow *Phacelia tanacetifolia* in proximity to the crop to attract Aphid predators into the Sweetcorn at the critical infestation time - Protocol reference: Section 8.1.2