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The Canon of Potato Science:

20. Volunteer Potatoes

M. F. Askew · P. C. Struik

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What are they?

Volunteer potatoes, also called groundkeepers, are tubers of the potato (*Solanum tuberosum* L.) which produce unwanted potato plants in a wide range of cultivated crop species. Since each plant can produce further tubers, a potential to increase populations as with other 'normal' weed species which produce true seeds, exists. However, volunteer tubers can arise vegetatively from mother plants or from true potato seed (TPS). Thus, groundkeepers can be 'normal' daughter tubers or seedling tubers. In all cases, it is the residual tubers from these primary sources that are called volunteer potatoes. Clearly, the ability to multiply by both vegetative propagates ('seed tubers') and seed ('true' or 'botanical' seed) enhances the potential problems that can arise from volunteer potatoes. Volunteer potatoes are a serious threat to crop production, since they may produce highly competitive 'weed plants'. They are particularly harmful in crop rotations with high frequencies of potato since they help to maintain or even increase the densities of soil-borne pests and pathogens.

Why are they Important in Potato Science?

No accurate assessment of the incidence of volunteer potatoes by country or geographical area has ever been recorded, although anecdote suggests that volunteer potatoes have potential to occur in virtually all potato growing areas where severe and penetrating winter frosts do not occur regularly. Potato tubers are susceptible to frost damage although the effects of frost in the field on the overall volunteer

M. F. Askew (✉)
Haddo House, Keepers Lane, Tettenhall, Wolverhampton WV6 8UA, UK
e-mail: Melvyn.Askew@btinternet.com

P. C. Struik
Plant Sciences Group, Wageningen University and Research Centre, Haarweg 333,
6709 RZ Wageningen, The Netherlands

population are probably overestimated in many parts of Northwest Europe in all but the most severe winters. Effects of frost on volunteer potatoes depend upon soil type, their position in the soil and on the duration and severity of the frost.

Since volunteer potato plants and tubers are in all respects virtually identical to the cultivated crop, they are therefore susceptible, according to genotype, to the normal potato pests. The effects of pests which cause blemishing (e.g., slugs (*Agriolimax* spp.), wireworm (*Agriotes* spp.) and cutworms (*Agrotis* spp.)) on volunteer populations will be minimal although it could be argued that volunteer potatoes would provide a food source for these pests and therefore help maintain populations.

The position with potato cyst nematode (*Globodera* spp.) and Colorado beetle (*Leptinotarsa decemlineata*) is quite different. In Britain, potatoes can be affected by *Globodera rostochiensis* or *Globodera pallida* according to genotype; the effects of volunteer potatoes in maintaining populations of these nematodes are examined later, but volunteer potatoes themselves will be affected by them. Effects of nematodes are generally to reduce yield and vigour of potato plants and cause tubers to be smaller than normal. Undoubtedly this will occur with nematode-infested volunteer plants too.

Like potato pests, potato diseases are able to attack volunteer potatoes in the same way that they attack unprotected cultivated potato plants. Undoubtedly therefore the foliage-destroying pathogens, especially Late Blight (*Phytophthora infestans*) will regularly destroy foliage of volunteer potato plants in geographical areas where cultivated potato crops are common and therefore the source of disease inoculum is high. This could limit reproduction of volunteers. The extent of pathogen infection of volunteers is unknown; their extent and effect as sources of disease inoculum are also unknown.

Why are they Important for the Potato Industry?

Volunteer potatoes have developed into a serious and expensive problem in agriculture. They are competing for resources with crop plants, can cause direct damage to the harvested produce and can contribute to the persistence and severity of many fungal, bacterial and viral diseases, as well as to the build-up of populations of pests and diseases. Especially with mild winters and without integrated control programmes the problem may increase. By minimising or damaging field leavings, by growing competitive crops and by use of suitable agrochemicals volunteer potatoes can be controlled.

Volunteer potatoes have the capability to create several detrimental effects:

(i) Disease carry-over to other potato crops;
(ii) Pest carry-over in foliage or tubers;
(iii) Yield and quality problems in potato and other crops, especially vegetables;
(iv) Additional cost.

In most developed agricultural communities, potatoes are produced vegetatively by use of so-called seed tubers. This has the benefit of ensuring clonal uniformity since all tubers are genetically identical. In less developed agriculture, there has been

considerable exploitation of true potato seed (TPS) which is produced in the potato 'berry'. Whilst such sexually produced material is less uniform than vegetatively produced clonal material, TPS is much easier and cheaper to store and transport than seed tubers; it is also more damage resistant.

With both sexually and asexually produced parental material being used in commercial practice it is hardly surprising that volunteer potatoes can and do arise from both tubers and TPS. However, the significant point of difference between commercial production and spread of volunteer potatoes is that both sources of volunteers can occur regardless of the normal commercial propagative method, for example, volunteer potato seedlings from TPS are not uncommon in Europe.

Incidence of Volunteer Potatoes from TPS

Laboratory experiments have indicated that TPS can retain a high degree of viability for at least 10 years and some seed will germinate after 20 years storage; field experience suggests that TPS can remain viable for at least 7 years. Since TPS can survive for long periods in the field it is important that long term cultivar popularity for cultivation and not solely current cultivar interest be assessed in order to assess TPS/volunteer potato risks.

Potato cultivars vary substantially in their expression of flowers and capacity to set true seed. Some cultivars such as the Dutch cultivar Bintje tend to produce flower buds which abscise before flowering, whereas other cultivars flower and set berries profusely thus producing enormous amounts of viable TPS.

The potato seedling developed from TPS is a much smaller plant and less vigorous than the cultivated plants established from traditional-sized seed tubers. Moreover, because this method of propagation is not clonal there is more variation among TPS seedlings than would be expected among plants established from seed tubers. Nonetheless, small tubers from TPS plants can readily produce seedling tubers and from those 'normal' potato plants in the following year, whereupon, the volunteer potatoes then formed are in all respects identical to those left behind after harvest of cultivated potato crops.

In addition to many cultivars having the capability to produce TPS, and thereby produce volunteer potato infestations, all those cultivars have the universal capability to produce volunteer potatoes from tubers or tuber segments, so long as these latter carry 'eyes'.

Volunteer Potatoes from Potato Tubers or Tuber Portions

The conventional harvesting procedure for potatoes leaves small and, in some instances, discarded large tubers in the field. Numbers remaining vary, but up to 500,000 tubers per ha could remain. This approximates to a 12–fold increase over a normal planting rate. Clearly these data are indicative of a general high level of field leavings but it must be accepted that this level would be affected by growing conditions (e.g., drought would generally reduce tuber size and therefore percentage of small tubers) and plant population (lower densities produce larger tubers and vice versa).

The vast majority of the potato area is harvested by machine and machinery design and mode of use undoubtedly have effects upon levels of tubers left upon the

field. It is not impossible to remove every tuber from the field but this is obviously impracticable since it would entail the removal of massive tonnages of soil (1 ha of soil to 10 cm deep weighs approximately 2,500 Mg) and the logistical problems of handling that would reduce the proposition to the absurd. Moreover, the damage caused to ware potato tubers in the process would be well beyond that which is acceptable. Hence, in practice, no harvester removes every tuber.

It is generally presumed that potato tubers remaining in soil will always break into active growth and produce shoots in the following spring. However, it appears in some cultivars, at least, that tubers can lie dormant but viable for at least 18 months. Even very small tubers can produce viable plants.

A strategy to control volunteer potatoes

1. Minimise field leavings or potato berries.
2. Once potato tubers occur in any field originating from cultivated crops or from volunteers, avoid burying them if at all possible.
3. Damage volunteer tubers or waste tubers if practicable.
4. Consider spring cropping and delayed seedbed preparation following potato crops where large numbers of field leavings occur.
5. Follow potato crops with vigorous, early established cereal crops. Ideally these should be winter wheat.
6. Treat volunteer potato plants in non-potato crops or on set-aside land with suitable agrochemicals for their control.

Scientific Developments

More research is needed on the spread of the problem and on its control. Therefore the following research, development and education activities are recommended:

1. Progress in volunteer potato control will not occur in the absence of severe winter weather unless their incidence is clearly assessed and rotational control programmes for their control applied to those areas. There are research, developmental and educational aspects to this problem.
2. Volunteer potatoes affect a range of crops and an overall integrated programme of research, development and education must be applied to their control.
3. The geographical incidence of volunteer potatoes and the level of their severity should be assessed.
4. Tactical control programmes must be constructed for each crop. These should be provided for the industry and their success charted. Any weak links in control should be researched further.
5. The effects of volunteer potatoes on pest and disease incidence should be monitored and strategies devised to minimise their adverse effects; this is of critical importance for seed potato production.
6. Set-aside in particular should be thoroughly studied. The effects of set-aside on volunteer potato populations and on 5 above, especially with regard to Late Blight, should be critically measured.

7. Various funding agencies should combine to fund research into chemical controls of volunteer potatoes where the area of crop species infested would not justify a totally commercially funded control programme.

Further Reading

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